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AVIATION

The Oldest American Aeronautical Magazine

A McGraw-Hill Publication

MAY, 1931

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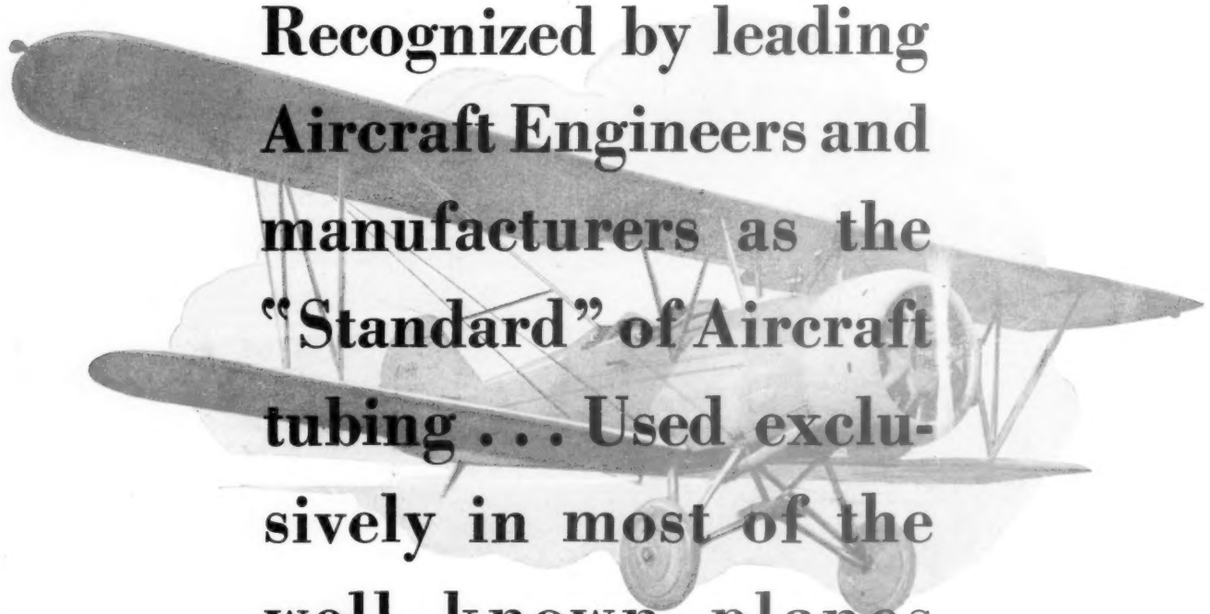

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AVIATION

A McGRAW-HILL PUBLICATION . . . Est. 1916

The Oldest American Aeronautical Magazine

EDWARD P. WARNER, *Editor*

LOUIS F. STOLL, *Publishing Director*

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Published monthly. United States, Canada and Mexico, $3.00. Central and South America, $6.00 a year. All other countries, $8.00; 35 cents a copy. Entered as second-class matter July 27, 1928, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Printed in U. S. A.

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McGraw-Hill Publishing Company, Inc.

Tenth Ave. and 36th St., New York, N. Y.

Cable Address: "Machinist, N. Y."

NEW YORK District Office, 285 Madison Avenue
BOSTON, 1427 Statler Building
WASHINGTON, National Press Building
CHICAGO, 520 N. Michigan Ave.
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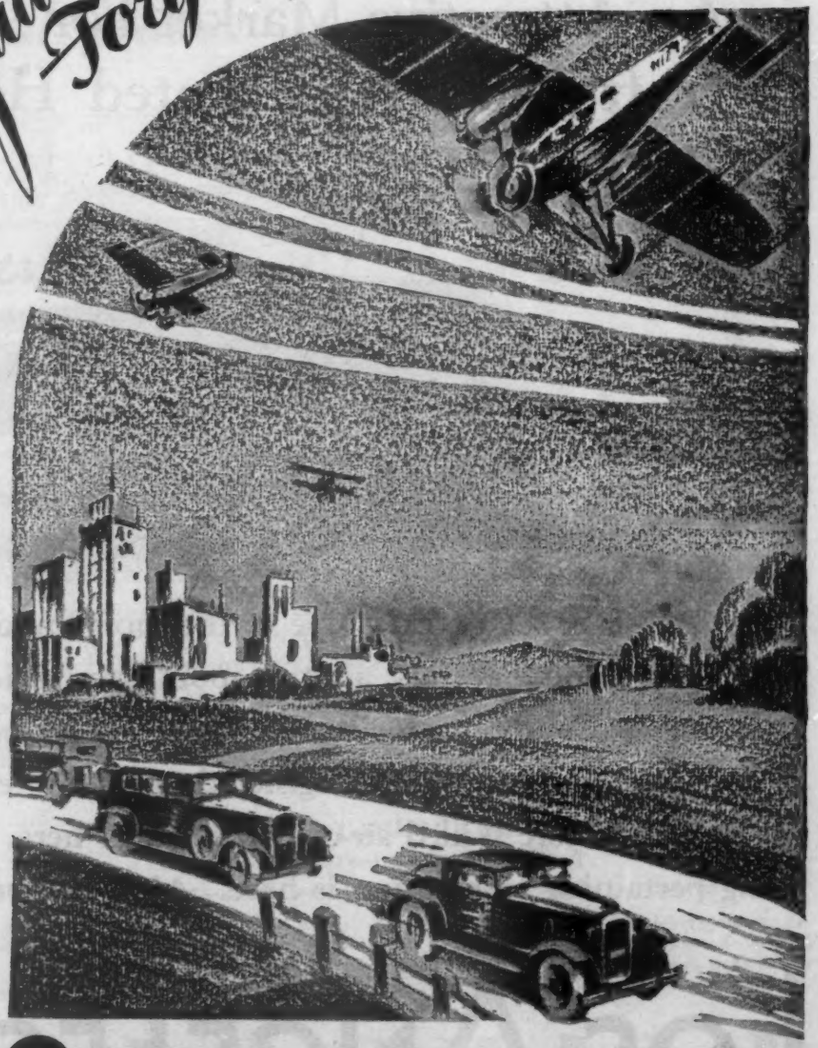

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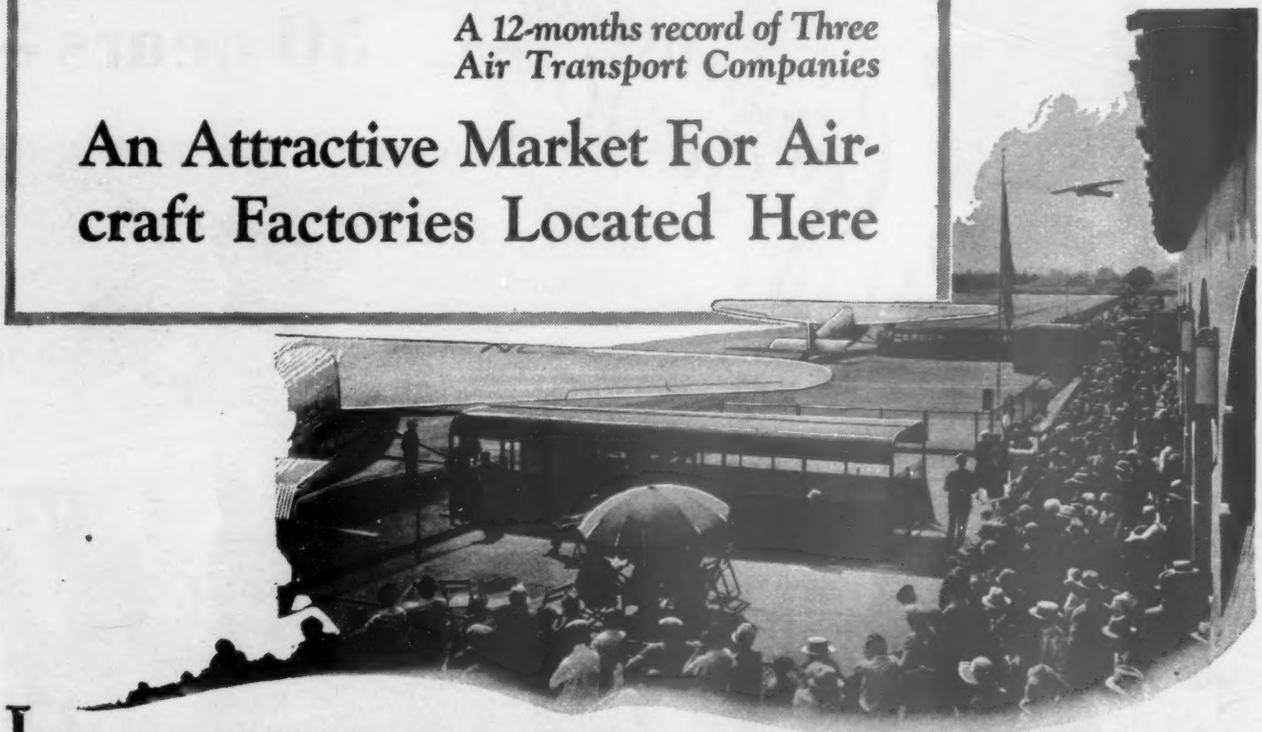

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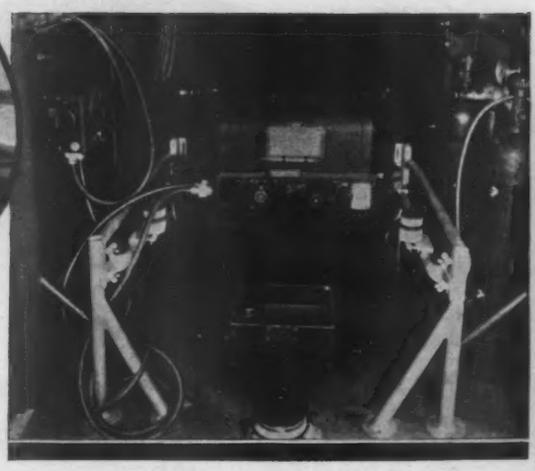

WHAT!

A heavy bomber to do the work of a pursuit airplane!

Left—The F-1 cameras are specially designed for aerial observers—they are a mechanical eye with a perfect memory. These cameras are so simple to operate, so perfectly suited for aerial observation that they really become a part of the observer's being and are operated without conscious thought or effort.

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Right—Military aerial mapping can be accomplished with a minimum amount of flying by using the four-lens Fairchild T-2 aerial camera. Taken from 15,000 feet altitude a single exposure (four photographs made simultaneously) covers 34.4 square miles and a single loading maps an area of 600.9 square miles allowing proper overlap.

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* *Italicized statements quoted from recognized authorities; names on request*

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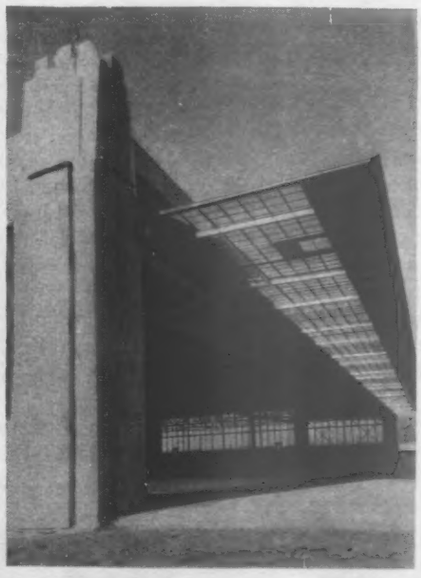

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Position..... **Firm**..... **City**..... A 5-31

AVIATION

A McGraw-Hill Publication . . . Est. 1916

The Oldest American Aeronautical Magazine

EDWARD P. WARNER, *Editor*

Volume 30 . . . *May, 1931* . . . Number 5

Accident publicity

IN the past nine months there has been little compulsion to give attention to transport accidents or to devise means of dealing with them. There has been little need, in particular, to think of those questions of accident publicity which became so lively a topic in Washington a year and a half ago, but immunity could not continue forever, and now the tragic occurrence in Kansas which cost the life of the best-known figure in American football has brought the matter again very much to the fore.

As is usually the case, in the argument between those who would have unrestrained publicity and those who would have none, both factions have had merit in their cause. It is perfectly obvious that there are some things that cannot, and others that should not, be done. As Secretary Young reminded the world at large, and the United States Senate in particular, a year ago, the Department of Commerce cannot in decency violate the confidences of men who have testified under an implied promise of secrecy. It could not expect to get full and frank statements of all the contributory causes of an accident if it should begin to hold its investigations under a spotlight. The conditions of an airplane crash are peculiar. Statements by witnesses are not readily subject to the sort of checking by cross-examination and cross-checking by correlation with each other that can be applied when probing the causes of a boiler explosion or a shipwreck.

The Department cannot, or at least it very definitely should not, give out speculations about underlying causes unless they be very definitely identified as speculations. The very fact that the Department's personnel are the leading authorities, and that their guesses are likely to be accurate where there is no positive evidence, is in itself a danger. Where a coroner ignorant of aeronautical matters, or some other incompetent local official, hands down a pontifical pronouncement upon the cause of a disaster the probability of its being erroneous does but little harm, for intelligent men give it but little weight and if it be offered as evidence in court its validity can easily be challenged. The declared opinions of the Aeronautics Branch of the Department of Commerce take rank with the law and the prophets, and they must not be delivered lightly. The dangers of premature declaration by that high authority were amply demonstrated in the Bazar crash, where evidence subsequently discovered demanded withdrawal of the most important section of the Department's original estimate of the underlying cause.

But without violation of confidence and without incurring serious danger of misleading the public, there are some things which can and should be done. The Department of Commerce can state definitely determinable facts. No one else can do it so well, for the Department is an impartial and a competent authority, and its representatives are ordinarily among the first upon the scene of a wreck. When questions of fact can be answered by the examination of material, *and when the examination has been sufficiently thorough to make reasonably sure that the answers are correct,* they should be made known. The value of definite

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information on material failures is too great to justify withholding it because of the possibility that its release may hurt some feelings in the industry. When the deductions from the facts are positive and certain, those too, should be made known. Still further, when the mute evidence of the wrecked aircraft points to certain conclusions as strong probabilities, they should be reported as just what they are—strong probabilities.

But the possibility of investigating materiel factors, and often determining material causes with a certainty seldom attainable in appraising the personnel element, suggests the desirability of having two different methods of procedure. It is in respect of personal errors that accurate information is hardest to draw out in open court. It is in respect to materiel troubles that investigation in open court and the taking of the consensus of expert opinion, with interested manufacturers having a chance to be heard, is most important. When a court martial is held in the Army or Navy, the members of the court have the privilege of deciding for themselves whether or not their meetings will be public. The decision naturally rests in large measure upon the nature of the case and of the testimony to be introduced. The Department of Commerce ought to exercise the same privilege of decision. The accident in Kansas last month is a perfectly clear case for open hearing. There have been others in which it would have been equally clear that an open hearing would have defeated the ends of justice. Admittedly, the choice between the two methods and the decision upon the amount of publicity that shall be given imposes an extra responsibility upon the Department of Commerce, of which its officials would doubtless be glad to be relieved. But there seems to be no reasonable way out.

It is impossible to arrive at any single rule or method which will suit all occasions. All sorts of hypothetical schemes of aircraft regulation are being launched nowadays, in Washington and elsewhere. There is no reason to think that any of them that have been proposed would be as satisfactory as a continued reliance upon the Department of Commerce. To protect the public, however, and to enable air transportation to deserve public support, the Department must be free to use its discretion in dealing with each catastrophe. It must be free to take its decision with sole reference to the ultimate good, and it must sedulously avoid being forced by public clamor over any particular accident to act prematurely before the facts are all in or to give more publicity or less than the circumstances of the particular case justify.

The Department of Commerce has had some unhappy experiences over this matter of publicity in the past, and its officials have been pushed in all sorts of directions and urged to all sorts of sudden changes of policy. It is of the first importance that it be made clear that there cannot properly be any standardized policy, and that an attempt on the part of any member of a political body to make aircraft accidents into a political gonfalon can serve no proper public interest.

You don't say so!

IT IS always pleasant, and sometimes it is absolutely necessary, to engage in controversy with the sprightly gentleman who subscribes himself C.G.G. He is always amusing and always provocative of thought, especially when involved in an argument. His readers, both in England and abroad, include a great many who have followed him faithfully through years of almost invariable dissent from his views. Voltaire might well have foreseen and have been addressing Mr. Charles G. Grey of *The Aeroplane* when he wrote "I disagree with everything that you say, and I shall uphold to the death your right to say it."

Mr. Grey is wont to castigate his fellow countrymen for the good of their souls, and occasionally he manages to chafe them severely, but in times of strain he suddenly takes his place as the lead horse of the team and reveals himself as unshakably and unquestionably Britannic. When the British industry goes abroad, to a Salon in Paris or to an Empire Exhibition in Buenos Aires, C.G.G. can be relied upon to drape the fragrant leis about its neck and adorn its brow with a handsome succession of laurel wreaths. Sometimes the accomplishments of non-British builders and operators of aircraft are overlooked during the process.

When Mr. Grey or anyone else makes a categorical statement that British airplanes and British pilots are best in the world, there is nothing to be gained by attempting rebuttal. The observation is too vague to admit of discussion. The only possible reply is: "'Tain't so," and there is likely to ensue a debate having all the dignity and value of the alternate and perpetual repetition of: "Katy did"—"Katy didn't." Categorical claims to superiority for any nation (America included) are always absurd. Specific statements of superior performance in definitely identified particulars can sometimes be upheld.

Our talented contemporary has recently been somewhat more specific than usual. Hence these observations.

Upon ten points, he says, the British industry leads the world. The normal bounds of editorial space forbid us to discuss all ten, but let us examine one or two.

"British air transport machines," declares the oracle, "have proved themselves to be nearer paying propositions at reasonable fares than have the aircraft of any other nation." We don't know just what constitutes a reasonable fare, but whatever it is, fares per mile on American lines are in practically every case lower than those prevailing on Imperial Airways. The contribution of the American government to air transport per unit of traffic handled was less than half that of the British government in 1930. The general type of plane that has been most extensively used in America has made so good an impression that the latest order placed by Imperial Airways is for machines in the same general category, the first cantilever monoplanes that

have ever received a sympathetic examination for transport use in the United Kingdom. So much for point number one.

Mr. Grey has nothing more to say about transport planes, but the subject, now that it has been introduced, seems worth pursuing. We note with interest that an American light transport has knocked 25 per cent off one of the most highly valued of Empire records, that from England to South Africa,—that the Englishman who flew the machine came to America to buy it after a vain effort to find anything satisfying his needs within the British Empire,—that a member of the British peerage has recently purchased a Ford plane for his personal use, in spite of the tremendously strong sentimental campaign in favor of Empire products,—and that the president of the F.A.I. acquired for his personal travels, which will presumably be entirely within the eastern hemisphere an American machine in the face of the competition of all the European countries and in spite of their great advantage of propinquity.

Following the theme yet a little further, we discover that there is no really fast light transport, nothing in the class with the Lockheed, or the Monomail, or the Fleetster, or the Northrop, built in the British Empire. We discover that in no country except America has there been any serious attempt to develop a refined transport amphibion of reasonably large size. Nowhere else has the aircraft constructor attacked with any success the problem of the airline which must serve a route between points where there are harbors but no airports and points where there are airports but no harbors.

"Our aero engines," says Mr. Grey, "lead the world." Detailed comparison upon that score would demand a dozen pages of technical argument. We have the greatest respect for the engines that won the Schneider Trophy in 1929, but the test of the commercial quality of a product is the judgment of the intelligent purchaser free from national or personal bias. It is interesting to note that the latest purchases of the Royal Dutch Airlines from a Dutch airplane factory will be equipped with Wasp engines, succeeding a number of earlier orders for machines of the same general type, but fitted with power plants of British design. It is interesting to note the standing of American engines in Canada. It is interesting to note that an American factory was the first to produce a commercially available aircraft Diesel, a type upon which research had been long and energetically prosecuted in Great Britain and other European countries.

Of the eight points that remain in the formidable enumeration, at least four are similarly open to serious challenge. The four that remain possess a large measure of validity. They could be offset by a listing of four, or for that matter of forty, points of superiority in the product of the American industry.

But what would be the use? These claims of inherent national supremacy are always futile, except as they may produce some effect upon the mind of a singularly naïve and inexperienced overseas buyer. We have the greatest admiration for the British industry. Its products are excellent. In some respects, upon which special attention has been focused under government compulsion or otherwise, British aerial development leads the world. There are other points, and we believe them certainly at least as numerous, upon which present supremacy rests with the United States. American aircraft are especially marked by the ruggedness that pioneer operations far from service stations demand, and by ability to stand flying loads much heavier than are anticipated in most other plane-manufacturing countries. American manufacturers, both of military and civil aircraft, and American transport operators have a record that they can be proud to lay before the judgment of the world. They do not need to seek preference from the foreign purchaser merely because they are American. Their products and their performances stand upon individual merit, and ask only the opportunity of demonstration.

Too many beacons

LIGHTING the national air routes of the United States has been a monumental task, thus far ably performed by the Department of Commerce. Many private beacons have been erected along air routes or near airports. These have been certified by the Department of Commerce wherever they represented a real contribution to air route lighting.

Effective the beginning of this year, the Department announced new and more strictly defined conditions under which non-governmental beacons will be certified and permitted to operate. All airport beacons shall be green, or equipped with auxiliary multi-source green beacons flashing a Morse Code identification of the port. All air route beacons shall be provided with green auxiliary lights if landing facilities are available and with red auxiliary lights if there are no landing facilities. All landmark beacons not located directly on an air route or an airport, and this class includes all downtown beacons, must be red in color unless specifically excepted by the Secretary of Commerce, and must be equipped with a fixed projector pointing to the nearest landing field, or airport.

Even if that plan had been promptly carried out to the full, the problems of a pilot traveling a new route at night would still have been quite complicated enough. Gone forever are the days when every airway beacon marked a point on the straight course from New York to San Francisco. Come up from Tulsa towards Wichita now, or fly over Chicago, and airway lights blink in every quarter of the compass.

Unfortunately for the welfare of the night pilot there are many "bootleg" beacons in operation. These

are usually erected by private firms for advertising purposes. They were hailed with enthusiasm, in the excitement of the trans-Atlantic era three years ago, as proving the existence of an exceptionally high degree of local "air-mindedness." Now they are recognized as constituting a real hazard to night flying, which should no more be tolerated than would be the erection of a false beacon near the entrance of a busy harbor. The Department of Commerce has inaugurated a campaign to eliminate all non-certified aeronautical lights. All members or friends of the aviation industry can be of the greatest service in helping to locate and bring about their discontinuance.

Autogiration and the private market

THE grimmest fact that the aeronautical industry has had to face in the last two years has been the failure of the private purchaser to come up to expectations. He has remained persistently coy, so well hidden that a private market can hardly be said to have existed. There have been many reasons. Widespread financial stringency has played a great part. Inaccessibility of airports and poor servicing facilities have been a large factor. So has the wide-spread impression that airplanes are too costly in comparison with automobiles or some other article of machinery, but the greatest factor of all has been the refusal of the average man to accept the thesis that it is easy to fly.

Popular feeling on that point has little to do with the facts. Most people think that it is hard to fly, and whatever they may be told they continue to think it, for three reasons: they have read reports of a good many airplane accidents; the process seems an unnatural one, wholly outside of human experience until a few years ago; and last but not least, everything about it appears to take place with such dizzy rapidity that the novice feels that piloting must all be done by instinct, because there would be no time for meditation.

In that last observation lies a major clue to the trouble with the private market. The thing that alarms the novice most about an airplane is the inability to slow down for calm reflection. The machine approaches at what seems a terrifying speed. Uneasiness on that score is fundamental. It is gradually diminishing as the amount of human experience with flying increases and as flying soaks slowly into the consciousness of the average man, but the process of its disappearance cannot be much accelerated by argument or by the citation of statistics. Uneasiness about flying—we are not talking here about a definite fear of any definite danger—cannot be combated by logic, for it resides in the heart, or perhaps more accurately in the pit of the stomach, not in the gray matter.

The best instrument that has yet been produced for overcoming uneasiness and nervousness about private flight and personal operation of aircraft is the autogiro. It is the best because it strikes at the very root of the trouble. It gives the impression of taking the rush and flurry out of aviation.

It is eight years since Juan de la Cierva made his first cross-country flight in a rotor machine, and about three years since the Pitcairn organization took the American license for the type. Watching it all that time, we have remained relatively non-committal. We have the normal amount of human reluctance to accept a new idea. But resistance has gradually weakened. The introduction of mechanical starting for the rotor and the display given last fall at Chicago would have gone far towards the conversion of any sceptic. The performances there, taken together with the demonstrations almost immediately following, have moved us to unreserved acclaim.

It is foolish to become over-enthusiastic about any innovation. It would be foolish to suppose that the introduction of the autogiro automatically makes the popularization of private flying and the mass production of airplanes an accomplished fact. The type has special problems of its own, but at least it is conservative to say that it will offer to the fixed-wing machine very serious competition indeed in the private market and for the favor of the small industrial user. We can go further. Unless the sort of study that was promoted by the Guggenheim Safety Competition, and then in most cases allowed to lapse, is resumed—unless some fundamental novelty is introduced into airplane design to increase the flexibility of performance and reduce the accuracy of judgment required from the pilot in unfavorable circumstances—the airplane will be largely supplanted by the autogiro in the private field. We neither welcome that prospect nor resent it. We simply state it as a fact.

When a promising novelty appears in competition with an established product there are three ways of greeting it. The first, and the most popular, is to proclaim that it is no good, and to begin picking all sorts of flaws, frequently unimportant, in its design and performance. The second is to throw up the hands in abject surrender before the admitted superiority of the new rival. The third, and in most cases the most courageous course and the most sensible one, is to treat the appearance of a new and radical development along fundamentally new lines as a challenge to be met.

The autogiro can do some things that are inherently impossible for the airplane, but the gap between them need not remain as wide as it is now. Some of the light planes show progress towards closing it, but taken as a whole they represent only a short step. The Tanager and the Doodlebug ought not to be left as isolated pinnacles of experiment projecting out of an ocean of apparent indifference.

News of the Month

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Century Offers Frequent Trips

IMPORTANT among air transport events of recent weeks was the inauguration of service by Century Airlines, Inc., with headquarters at the Chicago Municipal Airport. Beginning March 23, it is offering three round trips daily between Chicago and St. Louis by way of Springfield, Ill., and four round trips daily between Cleveland and Chicago by way of Toledo with connections for Detroit. This schedule is soon to be increased to plane-every-hour frequency, the company promises. Flying time between Cleveland and Chicago is 3 hr. 25 min., between Chicago and St. Louis 2 hr. 55 min. The fare on the former run is $15.95, on the latter $13.95.

The company reported 163 paid passengers carried on the first day out of the 180 seats available. Executives of the company are: E. L. Cord, president; L. B. Manning, vice-president and general manager; William F. Bliss, assistant general manager in charge of operations; A. R. Bone, Jr., general traffic manager; and Fred A. Major, superintendent of maintenance. Planes are tri-engined ten-passenger Stinsons, similar to those used by Ludington.

Ludington Line, chief exponent of the high frequency service, is stepping up its operations still further. Doubled sections are now regular features of four trips each day. If half the passenger list is destined for the through trip, one section is flown directly to Washington or New York, as the case may be, while the other renders accommodation service and makes the intermediate stops. The company has added another plane leaving Washington at 6 p.m. and one leaving Newark at 6:45. Two new Stinson transports have been added to take care of the increases, and to permit operation on the newly acquired Washington - Charlottesville (Va.)-White Sulphur-Hot Springs line, formerly operated by Dixie Flying Service.

New Transcontinental Schedules

Passenger and mail service over the north and central transcontinental routes has been speeded up by schedules which went into effect April 1. Transcontinental & Western Air now crosses the continent in 33 instead of 36 hr. while National Air Transport and Boeing, by adding another trip each day over their lines, provide 31-hr. service westbound and 27½-hr. service eastbound, with tri-engined equipment throughout.

T. & W. A. Ford transports now leave New York (Newark Airport) at 10:45 instead of 8 a.m. and arrive in Los Angeles at 8 p.m. next day, with a night lay-over in Kansas City. Planes leave Los Angeles at 7 instead of 5 a.m. and reach New York at 6:50 p.m. the next day, also with night halt at Kansas City. Single-engined Northrops will later be used at night between Kansas City and Los Angeles to give 24-hr. transcontinental mail and express service in co-operation with the passenger planes.

Following the recent acquisition of Western Air Express stock by General Aviation Corporation, W.A.E. on April 15 moved from its own field to the United Airport at Burbank, leaving its $1,500,000 Alhambra Airport and the famous Hex-Hangar devoid of all activities. No disposition has been announced.

Calendar

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April 25-May 10	Annual Tour de France.
May 8-10	Second Annual Air Meet, Binghamton, N. Y.
May 10	Second Annual Sportsman Pilot Race, Aero Club of Pennsylvania, Patco Field.
May 15-17	Annual Air Races, Omaha.
May 15-24	First Annual Mexican International Exposition, Central Airport, Mexico City.
May 27	Sixth Annual Engineering Research Conference, N. A. C. A., Langley Field, Va.
May 15-31	International Aero Exhibition Stockholm.
June 8-15	F.A.I. Conference, Bucharest, Roumania.
June 15-20	Third Annual All-Indiana Air Tour, starting from Indianapolis.
June 29-30	Fourth National Airplane Model League of America Contests, Dayton.
July 4-5	Second Annual Air Meet, Joliet, Ill.
July 4-25	National Air Tour.
July 25	King's Cup Air Race, England
Aug. 29-Sept. 7	National Air Races, Cleveland Municipal Airport.
Sept 12	Schneider Trophy Contest over Solent and Spithead.

N.A.T. Fords leave Newark Airport, now at 9 a.m. as well as at noon, arriving at Chicago at 3:47 p.m. A Boeing tri-engined transport leaves Chicago at 4:30 p.m. and reaches San Francisco at 1:18 p.m. the following day. Eastbound planes leave San Francisco at 12:45 p.m. and reach Chicago at 11:09 the next morning. An N.A.T. plane carries the load on to New York, arriving at 7:24 p.m.

Changes have been made also on N.A.T.'s Chicago-Kansas City-Dallas line. The through plane now leaves Chicago for Dallas at 10:15 instead of 9 a.m., and another Chicago-Kansas City passenger trip has been added.

New Service Started

Most extended of the new airlines is the above-mentioned Century service. Other important additions or changes have been made. Blaine M. Tuxhorn on March 22 inaugurated a passenger service between Kansas City and Springfield, Mo., using Stinson Detroiters. He plans later to include Little Rock and Memphis.

Transamerican Airlines Corporation resumed its Detroit-Cleveland trans-lake amphibion service on April 1. The company's Detroit-Buffalo service has been suspended indefinitely. Mamer Air Transport resumed regular operations between Spokane, Wenatchee, Seattle and Tacoma late in March. Wedell-Williams Air Service has discontinued its daily operations between Houston and New Orleans because of insufficient patronage. Effective April 1, Western Air Service extended its Tulsa-Omaha line to Sioux City. The new direct Richmond-Jacksonville route, by way of Raleigh, N. C., Florence and Charleston, S. C., and Savannah, Ga., was opened April 2. Planes leave Richmond at 12:40 and reach Jacksonville at 6:40 p.m. They leave Jacksonville at 8:20 a.m. and reach Richmond at 2:40 p.m.

Parachute flares used on passenger transports henceforth must have Department of Commerce approval, according to a tentative ruling. Flares for planes carrying more than two passengers must burn at least 3 min. with 500,000 cp.

Traffic Increases

Domestic air mail poundage totalled 687,560 in January, as compared with 519,572 lb. a year ago.

Pan American Airways carried 1,652 passengers between Havana and Miami in February, a new record for this run, and during March Colonial Division of American Airways carried about 1,900 passengers between Boston, Hartford and New York, on the new six-round-trips-per-day schedule.

In the Department of Commerce accident report for the last six months of 1930, weather is blamed for 32.02 per cent of the accidents; power plants 22.34; personnel 15.32 per cent; airplane failures 14.90 per cent; airport and terrain, 11.70 per cent; darkness .53 per cent; and other causes 3.19 per cent.

Annual Reports

With annual reports for 1930 now in hand from Curtiss-Wright, Aviation Corporation of Delaware, Aviation Corporation of the Americas, and United Aircraft & Transport, practically all the most important groups in the aeronautical field have been heard from. These last reports, which are neither more nor less favorable than had been generally expected by those who have been closely following the industry, nevertheless drive home once for all the seriousness of conditions through which we have been passing. On an absolute scale the statement of United which reports a severe decrease in net earnings but still on over-all profit is of course the most favorable of the group. Net income for 1930 amounted to $3,302,206 or $1.24 a share on outstanding common stock, after caring for preferred dividends of $720,000, which must be compared with corresponding figures of $8,966,032 and $4.52 for the 1929 period. The balance sheet of Dec. 31 showed current assets of $23,844,830, of which cash and readily marketable securities made up $14,213,945. Current liabilities stood at $1,997,621.

The Aviation Corporation of Delaware and subsidiaries reported a net loss for the year of $4,703,601, Curtiss-Wright one of $9,012,919. These figures of course are alarming at first glance, but both of the companies present redeeming aspects. The beginning of 1930 marked the inception of a policy period of extreme retrenchment for the two companies. The Aviation Corporation initiated a severe writing down of book values on aeronautical equipment and securities and pursued throughout the year a ruthless plan of eliminating all of its subsidiaries whose promise of actual paying development was not immediate. Curtiss-Wright has possibly been even more drastic. During the year it decreased its surplus of planes, it wrote down its inventory by $2,254,842 and carried almost to completion its reorganization and consolidation plans. General and administrative costs are reported to be only half what they were a year ago.

The report on the year's operations for the Aviation Corporation of the Americas, better known as the Pan American Airways, was covered in AVIATION last month (p. 202).

Western Air Express reported a net operating deficit of $200,670, President Hanshue pointing out that operations of poorly paying lines early in the year in order to become eligible for mail contracts cut deeply into income for the period and that changes in service and mail contracts should insure a more prosperous result in 1931.

From St. Louis comes the announcement that Oliver L. Parks has regained control of Parks Air College through repurchase of 103,998 shares from the Detroit Aircraft Corporation.

Another deal for reacquisition of stock control was recently consummated between Sherman Fairchild and the Aviation Corporation. Fairchild emerges with control of the Fairchild Aerial Camera Corporation, Fairchild Aerial Surveys, the Kreider-Reisner Aircraft Company, and Fairchild of Canada. Aviation Corporation retains the Fairchild Airplane Manufacturing Corporation, and the Fairchild Engine Company, which last two companies will henceforth be known as The American Airplane & Engine Corporation, and the manufacturing plant at Farmingdale, L. I.

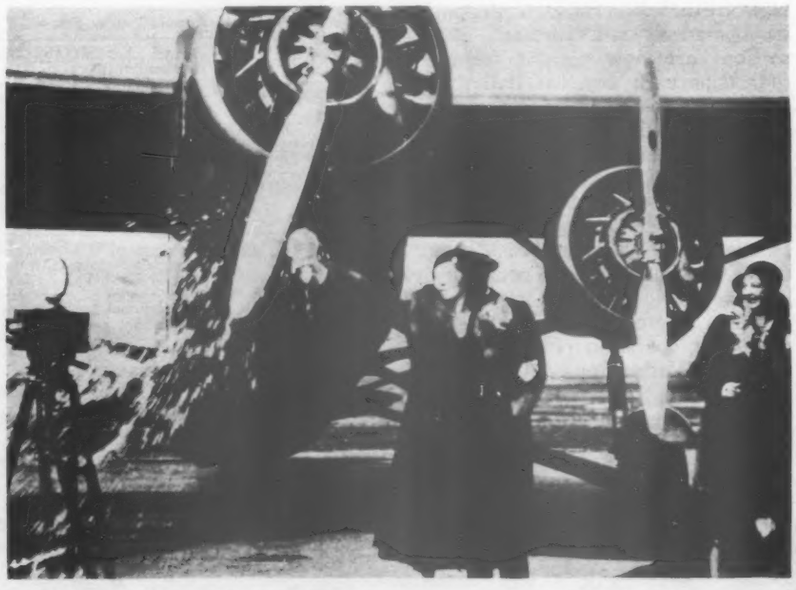
Interesting in the light of the above financial reports is a recent issue of Standard Statistics Company's bulletin with an analysis of the most important aeronautical stocks. Summarizing its advice on securities in this group, it says: "In view of indications that necessary liquidation in the industry has not yet run its course, we advise that long pull purchases of aircraft securities be postponed for the present. Stock prices in the group have recently advanced sharply, in reflection of normal seasonal forces, as well as strength in the general list. But because of the relatively adverse outlook for the trade during 1931, these seasonal rallies, as we previously have advised, should be utilized to liquidate present commitments. A more secure opportunity will be available at a late date, in our opinion, for placing investments in this field."

From France comes the financial report of the Gnome and Rhome Company. Net profit for the year was $1,183,720, of which about $320,000 represented royalties received from foreign firms manufacturing its engines under license.

Safety Records

The excellent safety record which the airlines have maintained for the last eight or nine months was marred March 31 when an F-10 belonging to Transcontinental & Western Air crashed at Bazaar, Kan., killing instantly the six passengers and two pilots. The accident was followed by the usual speculation as to cause. Various investigations followed and as a result of its finding, the Department of Commerce reversed its long-argued policy of strict confidence on crash investigations and released an official explanation.

Apparently, the department said, the propeller on a wing engine had broken, causing violent vibrations which weakened the wing to such an extent that it broke off. Within a few days, however,



HIGH-FREQUENCY SERVICE

Following christening of one of its fleet of Stinson tri-engined transports Century Airlines began operating what is to be a high-frequency service between Chicago and Cleveland and between Chicago and St. Louis, patterned after the Ludington Line.

this explanation was rescinded. The substituted explanation was that further excavations at the site of the crash had revealed the missing propeller, negating the broken propeller theory, and that further study indicated unfavorable weather had been the cause. A mail pilot who flew the same route about the time of the accident reported extreme ice conditions, low rolling fog and reduced visibility.

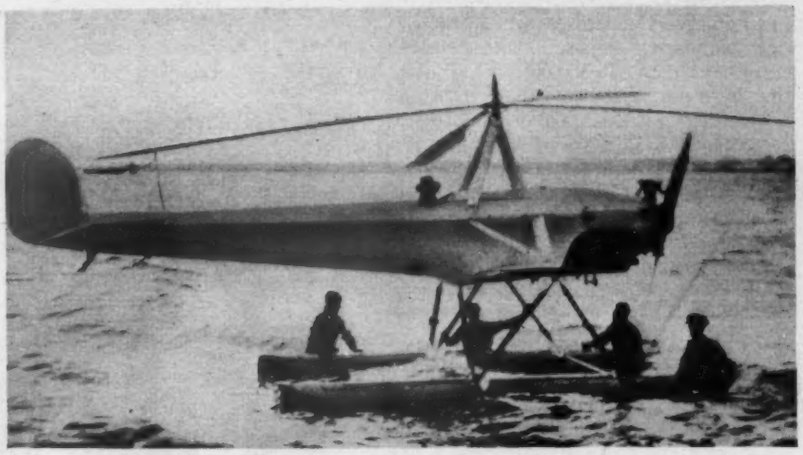
The Department of Commerce says: "The pilot of the airliner, knowing from his radio conversation with Wichita that the weather was clear at that place, was believed to have started up through the low clouds to get above them. In doing so, it is thought that ice collected on the plane and possibly rendered inoperative certain of its instruments that function through the air streams. Without these instruments to assist the pilot, the plane apparently went into a steep glide. The result seemed to indicate that when coming out of this maneuver, the change of direction occurred at such unusual rapidity as to build up an enormous load on the wing, which in return brought about the wing failure."

Telegraph Companies Handle Tickets

Postal Telegraph and Cable Corporation has entered into an agreement with a number of airlines to provide ticket and information service to purchasers through its offices everywhere. This makes every Postal office an airline ticket agency, the service even including delivery of tickets to home or office and all without charge to the purchaser. The contract used between the airlines and the telegraph company is approved by the transport section of the Aeronautical Chamber of Commerce. Western Union Telegraph Company, which has been co-operating with a number of airlines in a parcel service for some time, has similar arrangements with a number of airlines using its own contract.

Airplane advertising cards similar to the conventional street car cards are making their appearance. Air Ads, Inc., of New York City, of which Sumner S. Sewall, formerly traffic manager for American Airways, and Clinton Elliott are officials, is promoting this method of advertising. Cards are now appearing in the Ludington Line planes.

An air package and parcel service of the Air Ferries, Ltd., of San Francisco, has been inaugurated, using motorcycle delivery cars for pick-ups and deliveries to and from the planes. There are now 32 daily trips across the Bay and packages not weighing more than 50 lb. are delivered anywhere in the Bay district for a maximum charge of $.75. Where delivery or pickup is necessary at one terminal only, the charge for handling is $.50 and where no pickup or delivery is necessary, the charge is $.25. Monthly rates are quoted, and it is reported 175 firms are patronizing the service.



THE 'GIRO GOES AQUATIC

The seaplane autogiro tested in England last year. Preparations are being made to test the autogiro principle on a Short Brothers flying boat.

European Lines Plan Changes

In Europe the airlines are getting on summer schedules or resuming services suspended for the winter season. K.L.M., the Dutch transport company, is planning to make its bi-weekly Amsterdam-Batavia (Dutch East Indies) service a weekly one in September. This line has been operated very successfully from a technical point of view since September of last year, but the economic results have been below expectations. The company is seriously considering extension to Melbourne, Australia, through its subsidiary K.N.I.L.M., which operates in the Dutch East Indies

K.L.M. contemplates accepting passengers on the mail planes soon. Fare will be $1,000 to Batavia, not including hotel expenses. At the present time about 400 lb. of mail, one-third of the available capacity, is carried. The Dutch Post Office pays the company $10,000 per trip, or a little more than $1 per mile, to carry the mail to Batavia. The Dutch East Indian Post Office pays about $7,500, or approximately $.75 per mile, for the return trip. Five Wasp-powered tri-engined Fokker F-12 monoplanes have been ordered from the Amsterdam Fokker works for the service.

Faster service is being effected by Imperial Airways through three new arrangements. First a closer coordination of schedules, and the improvement of arrangements for transferring mail and express between railways in the United Kingdom and Imperial Airways at Croydon. Second, about May 16 the company resumes the former direct route across Europe by way of Switzerland, Italy, Greece to Egypt, rather than across Central Europe. New agreements, overcoming the difficulties that forced the shift of route to the north, have been reached with Italy and Greece. Third, night flying on the Bagdad-Basra section of the Indian service was to be started about April 11. The company will put into operation during May several new all-metal Short Kent flying boats, each powered with four Bristol Jupiters, for the Mediterranean section. Each boat will accommodate seventeen passengers and 1½ tons of mail.

The company on April 4 started experimental London-Australia mail trips on a fifteen-day schedule. It unfortunately ended in a minor crash.

Aeropostale's financial difficulties continue. The issue seems be whether or not the government will grant a generous subsidy to the company, and how long it should be applied and how much direct government control should be exercised. Coupled with this situation is the inquiry into the affairs of Pierce-Etienne Flandin, who while finance minister also served as legal counsel for the company.

The 1931 German Aeronautical Budget, recently submitted to the Reichstag, totals about $10,300,000, a drop of more than $600,000 from last year's appropirations.

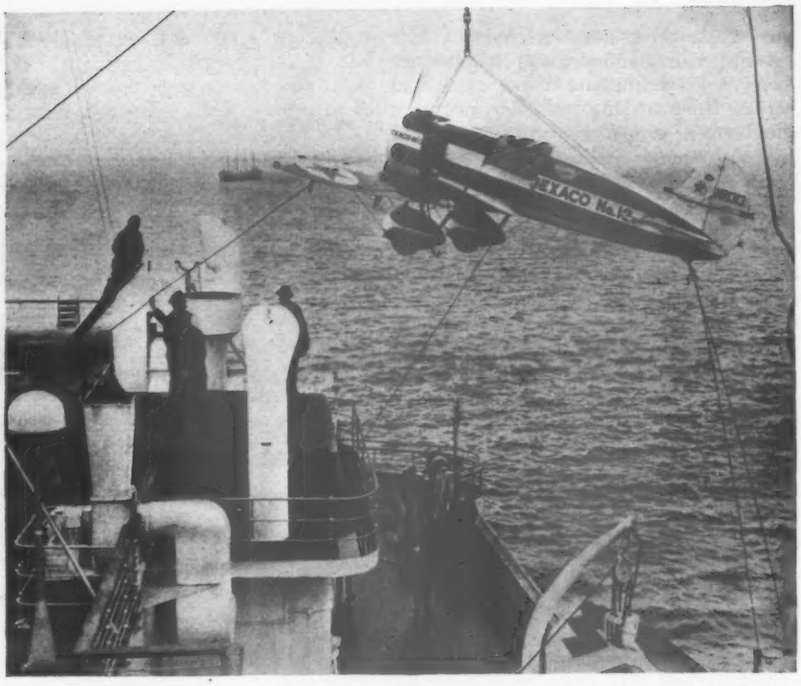
The appropriation for subsidizing the German Aeronautical Research Institute is $367,000, about 1 per cent less than last year. Lufthansa would receive $3,700,000 for European Routes and about one-fifth of that sum for promotion of traffic on routes outside of Europe. These appropriations are slightly under those of last year.

The German school for the training of commercial pilots gets $542,000; gliding and soaring $71,400. For the encouragement of south trans-Atlantic Zeppelin service about $142,800 is to be appropriated.

The British air estimates for 1931 provides for a total of $90,500,000, an

increase of $1,250,000 over 1930. Technical and warlike stores (which includes new planes, experimental and research activities) gets $38,360,000. Civil aviation is to get $2,350,000, the Air Ministry will get $3,280,000 and meteorological services $1,225,000. The appropriation for new equipment is $380,000 more than last year. The meteorological appropriation is the same as a year ago, and the other two are slightly less.

The subsidy for the Light Aeroplane Clubs remains the same as last year, $75,000. That for National Flying services is $25,000, also the same as for 1930. There is an increase of $460,000 in the subsidy for Imperial Airways. Airship development and construction suffer, as was to be expected. About $295,000 is provided for airship development as compared with $1,710,000 in 1930, and nothing is provided for construction.



AN AMERICAN AVIATION ENVOY TO EUROPE

The Travel Air Mystery, flown by Frank Hawks on many notable flights in this country being loaded on shipboard for tour abroad.

Personnel Changes

Reorganization of the operations department of Transcontinental & Western Air followed close on the heels of General Aviation Corporation's acquisitions early in March of Western Air Express stock. Lieut. D. W. Tomlinson, formerly operations manager for Maddux and before that the leader of the Navy's "Three Sea Hawks," resigned as a division superintendent and Everett Drinkwater resigned as superintendent of maintenance. Clifford Mutchler was promoted from western division superintendent to assistant to Jack Fry, vice-president in charge of operations. Herbert Hoover, Jr., now is communication engineer instead of chief engineer. L. W. Goss was named assistant to Mr. Mutchler. Paul E. Richter, of the Aero Corporation of California, became western division superintendent and Walter A. Hamilton, also of the Aero Corporation, a division superintendent.

Frederick E. Seiler, formerly chief engineer with the Kreider-Reiser and then with the Kellett company, is now director of production for Heath Aircraft Corporation, succeeding the late Edward B. Heath.

N. A. Woodworth has been elected president and treasurer of Ex-Cell-O Aircraft and Tool Corporation. Phil Huber is vice-president and secretary.

William B. Hurlburt, vice-president of Bellanca Aircraft Corporation since May, 1930, has been appointed director of sales.

Walter F. Parlin has been named chief of inspection service, Aeronautics Branch. J. S. Marriott, former chief who resigned several months ago, has returned as assistant chief.

Paul H. Moore has resigned as superintendent of the Indianapolis Municipal Airport. Charles E. Cox, Jr., who has been assistant superintendent, succeeds him.

Frank Ambrose, former manager of the Curtiss-Wright Valley Stream (L. I.) Airport, has become manager of the Rockland (Me.) base of the Curtiss-Wright Flying Service, replacing Capt. William Wincipaw, resigned.

John Carroll is the new chief flight instructor at the Spartan School of Aeronautics, Tulsa.

Airport Development

The outstanding event in the airport field in recent weeks was the Third Anual Airport Conference at Tulsa, Okla., March 25, 26 and 27. Page 299 of this issue carries detailed report.

Six airports now have the Department of Commerce A-1A rating. Latest to join the still select group is the mile-square Wayne County Airport situated about 18 mi. southwest of Detroit.

Construction projects continue. Curtiss-Steinberg Field management has contracted for addition of a passenger station and waiting room to its Skyway Inn. Pacific Air Transport awarded a $75,000 contract to the Austin Company for design and construction of a field office and hangar on Boeing Field, Seattle. The structure will be of brick and steel, 122 ft. wide and 202 ft. long. It is to be completed by May 16. Baltimore has appropriated an additional $150,000 to strengthen the bulkhead enclosing fill for its new airport. Material is now being pumped into this area at the rate of 25,000 cu.yd. daily. Development of the Birmingham (Ala.) $1,000,000 municipal airport has reached an advanced stage and the official dedication has been set tentatively for May 30-June 1.

Army Orders More Planes

Assistant Secretary of War Davison announces that contracts for new aircraft and engine totalling $1,269,652 have been approved. The Pratt & Whitney Aircraft Company gets a $728,912.50 contract for 68 Wasp, Type SR-1340-E and 60 Type SR-1340-D engines and spare parts. The Thomas-Morse Aircraft Corporation received a contract for 30 observation planes, Type O-19E, and spare parts for a total amount of $450,910.76. The Northrop Aircraft Corporation was awarded a contract amounting to $62,600.90 for three Northrop transports and spare parts. The fourth contract was awarded to the Verville Aircraft Company for four primary training airplanes and spare parts for a total amount of $27,227.85.

With the idea of demonstrating the practicability of night cross-country flying the 17th Pursuit Squadron, Air Corps, consisting of 18 Hawks and accompanied by a Ford transport, recently flew from its base at Selfridge Field, Michigan, to Bolling Field, Washington, D. C., in 2 hr. 30 min., entirely during darkness. The squadron flight was in charge of Capt. Ross Hoyt.

Schneider Preparations

Announcement has been made that the 1931 Schneider Trophy Contest will be flown on Sept. 12, over English waters. The race will be a three cornered affair between teams representing England, France and Italy. The building of high speed designs by each of the three countries is progressing in utmost secrecy and at the present time there is little information available. The French team under Commandant Amaurich, is practicing on Bernard and Nieuport-Delage monoplanes designed and built for the 1929 contest. The planes to be used in the 1931 event will not be ready until the summer.

The British Schneider team this year will be almost entirely different from that of 1929 in personnel, but again Squadron Leader A. A. Orlebar will be in command. Two new machines are being built, and it is understood that they are likely to have steam cooling, and that the engine power will somewhat exceed the 1850 hp. of two years ago. The contest is to be held on Saturday, Sept. 12, over the Solent and Spithead.

Records Tumble

A number of new records have been made. Miss Ruth Nichols has been officially notified that she reached an altitude of 28,743 ft. in a Lockheed Vega with Wasp engine over New York on March 7. This surpasses the previous women's altitude record of 27,418 ft. held by Miss Elinor Smith, who since has reached an indicated altitude which may prove to be a new record.

The French did especially well in annexing records. Joseph LeBrix and Marcel Doret, the French stunt pilot at the 1930 National Air Races, made seven in one flight. They won records for duration and distance while carrying 500, 1,000 and 2,000 kg. loads, and for speed over a 2,000-km. course with the 2,000-kg. load. The new marks are 32 hr. 17 min. 48 sec. and 2,890.4 mi. (same for each class), and 93.8 m.p.h.

Two new records by Marcell Lalouette and Georges Reginensi were set on March 10 at Le Bourget with a load of 2,000 kg. using a Farman monoplane, Type 302, equipped with a 650 hp. Hispano water-cooled engine, fitted with a reduction gear. Distance covered was 1,664 mi. The time was 17 hr. 4 min.

The closed circuit non-refueling distance record was won away from Bossoutrot and Rossi by Jean Mermoz and Anthoine Paillard. The new record stands at 5,669.9 mi., about 186 mi. further than the old mark.

A gallant assault on the non-fueling duration record failed of success by only a few minutes. Using a Bellanca with a Packard Diesel engine, Walter E. Lees and Frederic Brossy remained aloft for 74 hr., 1 min. near Jacksonville, Fla. The present record is 75 hr., 23 min., and stands to French credit. The Lees attempt, the first long-distance flight to be made with a Diesel, was terminated by weather, while fuel for several hours still remained.

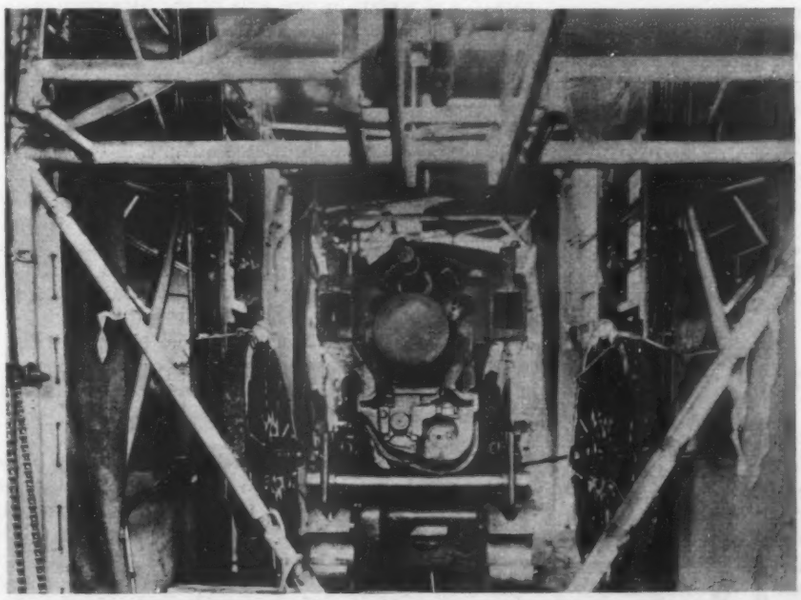
Italian pilots established two new marks. A Savoia-Marchetti S.71, powered with three Walters of 240 hp. each, was flown to 21,451 ft. The former record of 20,544 ft. made with a Caproni Ca-73. A Caproni 100 was flown to an altitude of 17,463 ft., establishing a new record for light seaplanes in the first category. The former record of 15,137 had been made by a Junkers Junior.

Two outstanding flights were the London-Cape Town trip by Lieut. Comdr. Glen Kidston in a Lockheed Vega, and the London-Australia tour by Charles W. A. Scott in a Gypsy Moth. Both flights were records for the route, the former covering the distance in 6 days 10 hr. as compared with 8 days 12 hr., and the latter in 9 days 4 hr. 11 min., beating Kingsford-Smith's time by almost 19 hr.

COL. Umberto Maddalena, one of Italy's most accomplished pilots and a member of the recent Italian trans-Atlantic flight, was killed with two companions in a crash in the water off Pisa March 19. They were flying a Savoia-Marchetti 64 seaplane.

Lieut. Charles E. Bauch, survivor of the Shenandoah crash, and first officer assigned to the new U.S.S. Akron, building at Goodyear-Zeppelin, was killed on March 31 in an automobile accident near Akron. He was inspector of construction on the new dirigible.

The death of André Jules Michelin in Paris April 4 removed another personage prominently identified with aviation since the early days. He was the donor of a number of well-known aviation trophies and at one time was the president of the Aero Club of France.



FIELD ARTILLERY TAKES TO THE AIR

This shows how one of the four 75-mm. field howitzers was stowed aboard a twin-engined bomber for transportation tests in the Canal Zone. The gun was placed in the fuselage through an opening in the flooring.

Plaintiffs Win Colonial Crash Suit

Most important of legal cases, not only for the past month but probably in the history of American air transportation, was that decided April 10, by a jury of the New Jersey Supreme Court. A suit for damages totalling $600,000 brought against the Colonial Western Airways, Inc., by the estates of six of fourteen victims of the crash of a tri-engined transport of that company on March 17, 1929.

After five hours of deliberation the jury found for the plaintiffs in all cases, fixing damages at various sums from $7,500 to $46,000, which totalled $89,000.

On the day of the accident the plane had been used for carrying passengers from the Newark Municipal Airport on sightseeing trips. On the final flight it took off with fifteen persons on board, the pilot made a climbing turn to the right, almost immediately thereafter one wing engine cut out and soon after the center engine lost considerable of its power. The pilot attempted to glide to

a landing, but the plane, now out of control, crashed into a sand-filled freight car and was completely destroyed. All the occupants with the exception of the pilot, Lou Foote, were killed immediately or died soon after of injuries.

Many are the points of law for which this case will form an important precedent. At the very beginning of the trial came the important decision absolving the City of Newark, and Lieut. Richard Aldworth, manager of the Newark Airport, both of whom had been named as co-defendants with Colonial by the plaintiffs. In granting their petition for non-suit Judge Dungan said in part, "In the terms of the lease between Colonial and Newark, no control is given the lessor, Newark, over the loading of the plane or its management or control; that is who shall operate it nor over the competency of the pilot, nor reliability of the plane. . . . I find nothing in the plaintiff's opening that will permit the jury to find any liability for Newark. . . . There is nothing . . . which would make the obligation of Lieutenant Aldworth any higher than the city whose agent he was."

Throughout the trial, which lasted three weeks, many well known and qualified flyers were called as expert witnesses. Among them Bernt Balchen, Clarence Chamberlin, Frank Hawks, and C. S. Jones. Technical testimony was also given by J. H. Scarr of the Weather Bureau, and Elmer M. Kintz of the Department of Commerce. Throughout the trial counsel for the plaintiffs endeavored to prove negligence on the part of the pilot, that the plane carried fifteen persons when it was only licensed for fourteen, that the day was dangerous for flying, and that the pilot was not familiar with the terrain at Newark Airport.

In his charge to the jury, which consumed over 2 hr., Judge Dungan emphasized the fact that the plane passengers assumed "all ordinary perils of airplane travel, all dangers which could not be avoided by the exercise of reasonable care . . . to find a verdict for the plaintiffs the evidence must show that the accident resulted from the fault or negligence of the defendant or its employees and that such fault must be the proximate cause of the accident."

Colonial is expected to appeal but has not yet made definite announcement to that effect. Meanwhile suits are pending for all the other eight victims save one.

Of somewhat the same tenor was the decision, awarding $4,000 to the daughter of James Eggert, one of five killed in a crash at Fairfax Airport, Kansas City, Kan., Jan. 25, 1930. Tried before the Wyandotte County District Court the defendants were the Central Airlines, the Universal Aviation Corporation and the Universal Airlines.

Legislatures Busy With Air Laws

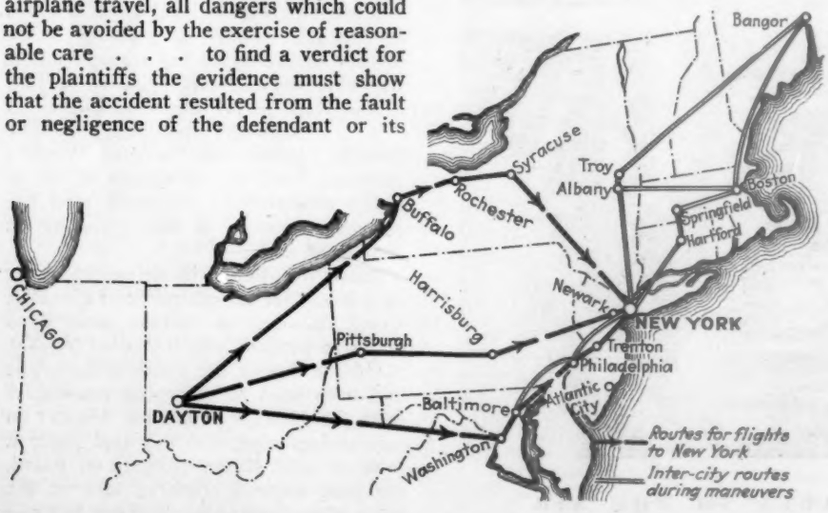
Recent legislative activity is centered in the important states of New York, Ohio, Illinois, and New Jersey, all three having acted in the general direction of strengthening their flying regulation. In New York two bills, both sponsored by Senator J. Griswold Webb, passed both houses of the legislature and have been signed by Governor Roosevelt. By their provisions the life of the present state board of aviation is extended and funds are provided for its operation. All pilots are required to be licensed by the federal Department of Commerce.

In Ohio a bill which greatly increased the powers of the state director of aviation and which raised his salary, passed both branches of the Legislature but was vetoed by Governor White on the grounds that, since no provision was made for publishing the regulations the director might make or for controlling their nature, such a person might easily abuse his increased authority.

An Illinois bill for the creation of a regulatory board of five, of whom two must be experienced pilots has passed the Senate and is before the House. In New Jersey a similar bill creating a director and an advisory board was being rushed through to enable immediate appointment of the personnel.

Generally the State Legislatures continue active on minor bills, over a dozen are considering gasoline tax laws, many of which have special provisions of exception or rebate to aeronautical users. Maine and Washington are considering the designation of aeronautical operating companies as public utilities.

The general subject of jurisdiction over flying in Canada having resulted in a dispute between the Dominion and the provincial governments, the question has been taken before the Privy Council for hearing in London. The dominion government seeks an overthrow of the recent decision of the Canadian Supreme Court, which stated that each province had control over aeronautical activities within its own borders.



SCHEDULED TO BE "INVADED" THIS MONTH

Routes to be taken by the Air Corps units in the annual maneuvers, using the largest number of planes ever assembled under one command in this country

Report on R.101 Blames Leakage

Chief interest in the field of lighter-than-aircraft centers on the recent report of the committee of assessors headed by Sir John Simon, late of the commission to report on Anglo-Indian affairs. After five months of investigation into the accident which resulted in the destruction of the R.101 and the death of 49 of its crew, the commission has found, in part. . . . "The accident was caused by a substantial loss of gas from one of the forward gas bags which most probably followed the ripping by the gale of the fore part of the outer envelope." There was no structural or control failure and no evidence of faulty navigation, according to the commission, yet they leveled serious reproach at the general decision to begin such a flight at that time. "It is impossible to avoid the conclusion that the R.101 would not have started for India on October 4 if it had not been that reasons of public policy were considered as making it highly desirable for her to do so if she could. She had never gone through trials which prove . . . that she was well able to cope with a continuance of unfavorable circumstances. The program of trial drawn up by her captain had never been completed."

Considerable conjecture is being made on the future of the R.100, although the Air Ministry has made no definite announcement, editorial comment, sentiment in Parliament, and practical indications point to a complete abandonment of any airship work in England. The London Morning *Post*, which has a definite place in the history of aeronautics as the purchaser twenty years ago of an airship from the Lebaudy Bros. of France for a presentation to

the British Government, said editorially: "Airships are too costly, risky, and unmanagable to warrant further expenditure at least by an impoverished country like Great Britain." Sentiment in Parliament and in other newspapers seems set against any further use of hydrogen, and Helium is considered impractical for the R.100 due to its cost.

Graf Zeppelin Adds to Achievements

A far different picture is drawn by the latest reports from Germany where plans for the ZL-129 have been announced and whose Graf Zeppelin has recently added a trip to Egypt with a landing at Cairo to its already impressive list of achievements. The new ship is to have a capacity of 7,070,000 cu.ft. and in addition to being inflated with Helium will be equipped with oil burning Diesel engines. Its launching is planned for 1933.

In this country all other developments continue to await the completion of the ZRS-4. Dr. Eckener has but recently returned to Europe after inspecting a number of possible sites for an airship terminal in the Chesapeake Bay region for the proposed commercial trans-Atlantic service.

In an exclusive interview with a representative of AVIATION, Postmaster General Brown reiterated his belief that airships should prove their worth on overland routes before any definite mail contracts for a trans-oceanic service could be considered. His latest suggestion is that a combination airplane and airship transcontinental service be worked out, the passengers to be carried on the airships during the night. Meanwhile, the Post Office Department is going ahead with plans for a heavier-than-air transAtlantic service. According to tentative plans, the carrier is to receive only the compensation earned from extra-postage of actual mail carried. Several routes are under consideration including one via Greenland, which has attracted the interest of Commander MacMillan, among others.

Pitcairn Wins Collier Trophy

As the industry meets at the Detroit show to display new models and to compare ideas on the coming season, the Autogiro continues to occupy a central position in aeronautical developments. Possibly most significant is the information that on a production of one each week their scheduled delivery is completely absorbed by orders until the latter part of the summer. Secondly, the Department of Commerce granted on April 12 an unrestricted approved type certificate to the Autogiro model PCA-2. Two weeks previously had come the announcement that the Buhl Aircraft Company of Detroit had joined Pitcairn Aircraft, Inc., and the Kellett Aircraft Corporation as licensees of the Autogiro Company of America, and will proceed with the development of a two place sporting model. Had none of this materially encouraging news come to Harold F. Pitcairn, he would still have loomed important in recent events, for on April 5 the National Aeronautic Association had awarded him the Collier Trophy for 1930 for his development work on the 'giro, "for the greatest achievement in aviation in America, the value of which has been demonstrated by actual use during the preceding year."

Stinson Aircraft announces a production during March of fifteen of its tri-engined transport planes with a total value of $400,000. Ten were delivered to the Century Airlines for the inauguration of its service between Detroit and Chicago, two more to the Ludington Lines and three to individual purchasers.

Two factory moves feature in the news of the past month. Curtiss-Wright have completed the shifting of their experimental division and engineering personnel from Garden City to the Buffalo plant which is now devoted entirely to military production. One hundred men were added by the move to the already large force in Buffalo, bringing the total of employees at the latter plant to 1,100, the highest mark it has ever reached. During the same period the American Propeller Company, formerly the Paragon, has been completely moved to South Bend, Ind., where it will occupy a new factory as a member of the Bendix group.

BACK TO LAKEHURST

From the "war" maneuvers. The Los Angeles being drawn earthward for a mooring to the portable mooring mast. Note the loudspeakers used for orders in the mooring operation.

Few Technical Announcements

Few technical developments figure in the news of recent weeks. From Paris and Berlin came reports of two new extremely light engines, the Romeiser and the Heylandt, which, if claims for them can be substantiated, would be revolutionary indeed.

In addition to National Air Transport's tests with the Goodrich rubber overshoe device for ridding wings of ice in flight, Charles Meyers on March 30 purposely flew a machine equipped with the device into ice conditions and reported the experiment proved satisfactory. Better than average weather conditions on the airways have limited service tests by N.A.T. this year.

Cowl Ruling Announced

A note of general interest to the industry is the announcement by the Department of Commerce that hereafter manufacturers or operators of aircraft which have been already approved may be fitted with auxiliary engine cowling without submitting drawings or undergoing further flight tests. All that will be necessary from now on is the approval of the district inspector.

Announcement of new models for the American market will be found elsewhere in this issue in reports on the Detroit Show. From abroad comes news of noteworthy planes.

In England the first of three Short Kent metal flying boats have undergone tests before delivery to Imperial Airways for their Mediterranean service. Powered with four 600 hp. engines, the machines will have a top speed of 130 m.p.h. with a total weight of 14 tons, of which 7,500 lb. is available for pay load. When three of this class and the recently ordered Handley Page Hannibals are delivered, the Imperial Airways will have a fleet of 34 planes averaging 1,415 hp. each.

A recent Air Corps News Letter brings an interesting compilation of enrollments in the Caterpillar Club for the year of 1930. As might be expected from the general increase in flying activities, more emergency parachute jumps were made in that period than during any previous year, 129 as against 91 for 1929, and 360 for the entire period since 1919. Most significant and indicative of the growing wearing of parachutes is the very large proportion of men outside the military services who have joined, 59 in all for the twelve months, and only seven of these were Airmail pilots. Out of 129 jumps, 127 resulted in the saving of a life.

Statistics of the Month

Material supplementing the statistical issue, AVIATION, March, 1931, appears regularly each month. Page numbers in the statistical issue are given.

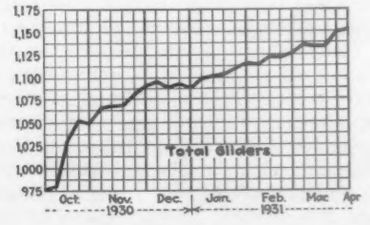
PRODUCTION AND LICENSING

Makes of Newly Licensed and Identified Aircraft, First Quarter 1931

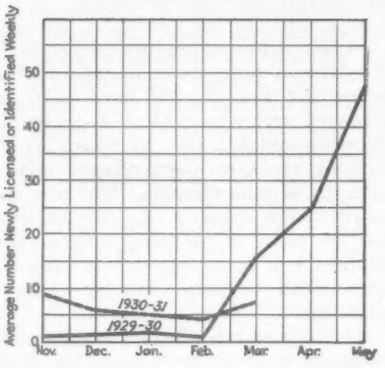
	Lic.	Ident.	Total
Aeromarine Klemm	3	1	4
Aeronca	5	2	7
American Eagle	..	1	1
American Eaglet	8	4	12
Amphibions (2 place)	3	..	3
Arrow	..	1	1
Bellanca (6 place)	2	4	6
Bird	6	1	7
Buhl	..	2	2
Cessna	..	1	1
Consolidated (Fleet)	5	..	5
Curtiss-Wright			
CR-2	..	2	2
Junior	14	..	14
Kingbird	7	..	7
Moth	2	..	2
Robin	5	..	5
Travel Air (biplane)	2	..	2
Travel Air (monoplane)	1	1	2
Detroit Lockheed Vega	6	..	6
Eaglerock			
Biplane	1	4	5
Monoplane	..	2	2
Fairchild			
KR	3	..	3
Monoplane	1	..	1
Fokker (single eng.)	1	..	1
Ford	2	..	2
Granville	1	3	4
Great Lakes	1	17	18
Huntington chum	..	2	2
International	1	1	2
Mono	8	3	11
New Standard	2	..	2
Nicholas-Beasley	1	3	4
Northrop (6 place)	1	..	1
Pitcairn			
Mailwing	..	5	5
Autogiro	..	1	1
Sioux	..	2	2
Spartan	..	6	6
States	..	2	2
Stinson			
Four-place	19	1	20
Airliner	2	..	2]
United			
Boeing (single eng.)	6	..	6
Sikorsky (single eng.)	1	..	1
Sikorsky (two eng.)	1	1	2
Stearman	2	..	2
Verville (monoplane)	..	1	1
Waco (open)	19	..	19
Miscellaneous	1	88	89
Total	143	162	305

Makes of Engine in Newly Licensed or Identified Aircraft

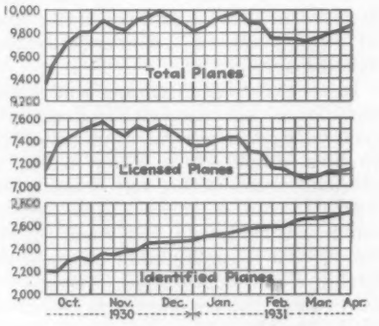
	Lic.	Ident.	Total
Aeronca	7	3	10
American Cirrus	1	21	22
Anzani	..	3	3
Anzani Cessna Converted	..	2	2
Chevrolet	..	1	1
Cleone	..	3	3
Comet	3	..	3
Continental	..	4	4
Curtiss			
Challenger	2	..	2
K6	..	2	2
Dodge	..	1	1
Ford	..	6	6
Gnome	..	2	2
Harley-Davidson	..	1	1
Heath	..	6	6
Heath-Henderson	..	9	9
Henderson	..	12	12
Hispano	..	5	5
Jacobs	..	2	2
Kinner			
B-5 (or unspec.)	14	3	17
K-5	..	2	2
Lambert	6	3	9
Lambert Velie	1	3	4
Le Blond	1	6	7
Le Rhone	..	2	2
Lycoming	20	..	20
Menasco C-4	..	1	1
Michigan Aero Rover	1	..	1
OX-5	2	9	11
Pratt & Whitney			
Wasp	12	2	14
Wasp Jr	2	4	6
Hornet	7	..	7
Szekely	22	10	32
Warner			
Scarab	18	2	20
Scarab Jr	1	2	3
Wright			
Whirlwind (165)	6	5	11
Whirlwind (240)	1	2	4
Whirlwind (300)	12	10	22
Whirlwind (220)	..	2	2
Gipsy	4	1	5
Miscellaneous	..	9	9
Total	143	162	305



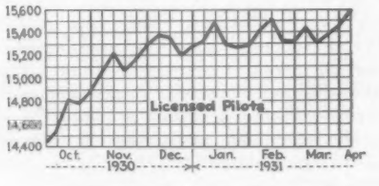
Valid Glider Licenses



Weekly Average of Gliders Licensed or Identified for the First Time



Valid Airplane Licenses and Identifications



Valid Pilot Licenses

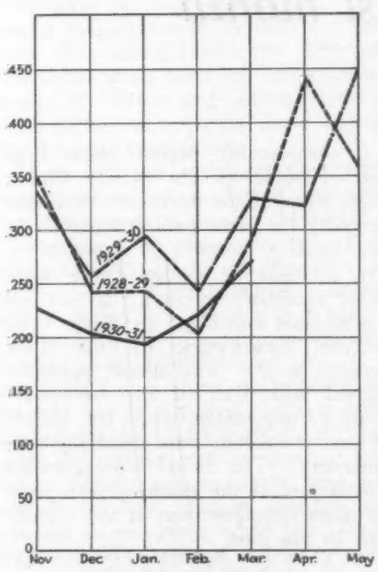
THE usual seasonal increase in the average number of student permits is observable in March of this year, but the upturn of the curve is less steep than in the two preceding years. In fact, the weekly average is about 20 per cent below that of 1930, and almost 10 per cent below that of 1929.

The same flatness is apparent in the curve for pilot licenses. However, though the rate of increase from February to March of 1931 is less than that of the preceding years, the average number of licenses issued weekly is slightly above that of 1929.

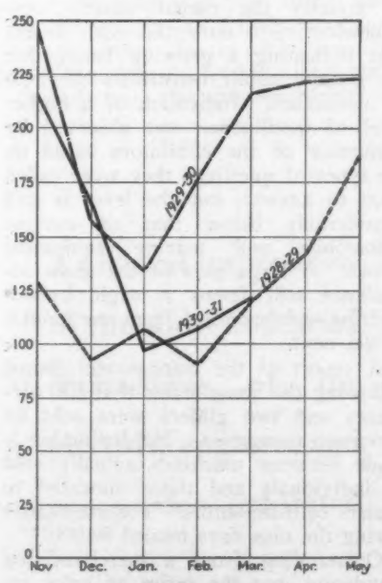
The curve of gliders licensed or

identified during the months of the past winter is well above that of the preceding year, but the spring upturn can in no way compete with the rise produced by the enthusiasm of the 1930 glider boom. In fact, as the identifications and licenses issued last spring expire, a drop in the curve for all gliders legally approved for service may be anticipated.

SINCE early in March there has been a steady increase in total planes, the curves for both licensed and identified planes turning with unusual consistency in the same direction. The curve of total pilot licenses valid is also unusually firm in its rise and at the end of the first week in April had reached a new high position on its chart.



Weekly Average of Student Permits



Weekly Average of Pilot Licenses

AIR MAIL AND TRANSPORT

(Page 153; also page 209 of the April issue.) Mail Poundage for 1930

A CORRECTION has been made in the figure for Weight of Mail Carried, for the month of August 1930, changing the total for the year from 8,086,543 to 8,003,657 lb. During August 695,318 lb. of mail were carried. This correction makes August the one exception to the rule that 1930 monthly totals for air mail exceed those of 1929, and also yields to December the position of peak month of the year. The corrected figures for mail carried on each route are given below.

Routes	Pounds of mail
1. Boston-New York	124,925
2. Chicago-St. Louis	61,370
3. Chicago-Dallas	439,050
4. Salt Lake City-San Diego	856,757
5. Salt Lake City-Seattle	312,689
8. Seattle-San Diego	289,045
9. Chicago-St. Paul	225,133
11. Cleveland-Pittsburgh	65,012
12. Cheyenne-Pueblo	89,399
16. Cleveland-Louisville	79,548
17. New York-Chicago	1,693,964
18. Chicago-San Francisco	1,955,145
19. New York-Atlanta	461,786
20. Albany-Cleveland	64,274
21. Dallas-Galveston	36,410
22. Dallas-Brownsville	89,404
23. Atlanta-New Orleans	109,906
24. Chicago-Cincinnati	77,210
25. Atlanta-Miami	188,213
26. Great Falls-Salt Lake City	63,499
27. Bay City-Chicago	184,774
28. St. Louis-Omaha	181,688
29. New Orleans-Houston	52,461
30. Chicago-Atlanta	123,968
32. Pasco-Seattle:(a)	83,028
33. Atlanta-Los Angeles(b)	46,347
34. New York-Los Angeles(b)	48,652
Total—all routes	8,003,657

(a)Consolidated with C.A.M. 5, July 1, 1930.
(b)Established October, 1930.

(Page 153) Contract Air Mail. January, 1931. Totals for All Routes.

Length of route	21,323
Scheduled round trips	1,190
Miles of service scheduled	1,976,586
Miles of service actually flown	1,770,406
Percentage actually flown	89.5
Total weight of mail	687,560
Amount paid to contractors	$1,449,676

(Page 151) Air transport operations, final summary, 1930. Domestic and Foreign Lines of American Operation

Passengers	417,505
Miles flown	36,945,203
Mail	8,324,255
Express	2,869,255
Passenger miles	103,092,382

FOREIGN TRADE

(Page 168) Aeronautical Exports for January

	1931	1930	Per cent Change
Airplanes			
Number	12	17	—29.4
Dollars	202,853	274,189	—26.0
Engines			
Number	15	25	—14.0
Dollars	112,127	100,748	+11.3
Parts and Accessories			
Dollars	205,847	198,318	+ 3.8
Total (Dollars)	520,827	573,255	— 9.1

FOREIGN ACTIVITIES

(Page 173) Foreign Subsidies and Appropriations

Belgium (1930-1931)	
Direct transport subsidy	$778,000
Total for civil aviation	1,858,000
Belgium (1931-1932*)	
Direct transport subsidy	931,000
Total for civil aviation	1,540,000

(Page 174) Annual Airplane Mileage in Air Transport, 1930

Belgium*	845,000
U. S. S. R.	2,440,000

(Page 175) Passenger Traffic in Passenger-Miles, 1930

U. S. S. R.	4,620,000

(Page 175) Express and Mail Traffic in Ton-Miles, 1930

U. S. S. R.	99,000

(Page 177) World Distribution of Airports Airplanes, and Licensed Pilots

	Belgium*
Civil airports	9
Military airports	8
Area per civil airport (sq.mi.)	1,306
Planes in transport service	42
Civil pilots licensed	396
Civil aircraft produced, 1930	29
Military aircraft produced, 1930	73

*Includes lines operating in the Belgian Congo.

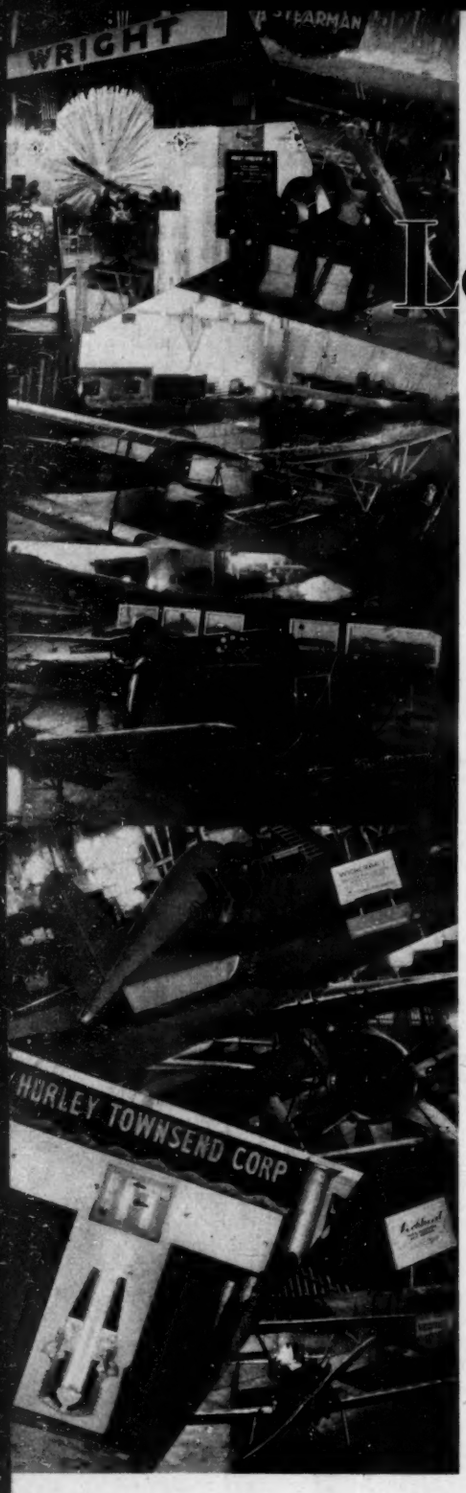
OFFICIAL statements of the progress of civil aeronautics in the U.S.S.R. are rare. In fact, no data regarding developments in this line since 1929 have been published either in the United States or in England. In view of that fact we consider it of interest to publish in his own words the statement of Comrade A. Goltzman, President of the All-Russian Association of Civil Aviation.

"The civil aviation of the U.S.S.R. is now passing through a critical period. The great progress made by our economy and the successful realization of the five-year plan is a period shorter than was formerly planned for, required a still greater development of the civil aviation than that which was being carried out and was presupposed by the former five-year plan.

"The government of the U.S.S.R. was thus induced to create an All-Russian Association of Civil Aviation in lieu of the airlines 'Dobrolet' and 'Ukrvosdukhputj.' This organization has the monopoly for exploiting all U.S.S.R.'s airlines, it unifies the development of the civil aviation in the Union and is dealing with the problem of training specialists for the civil aviation.

"In 1930 the length of our airlines increased comparatively to 1929 to 70 per cent (the fiscal year begins on the 1st of January and ends on the 31st of December). The distance flown in regular air transport during 1930 increased to 44 per cent.

"This year the civil air fleet of the U.S.S.R. uses airplanes constructed by Soviet engineers and manufactured at Russian works; the engines used are also manufactured at Russian works. We are now using on our airlines large tri-engined airplanes constructed by engineer Toopoleff."



Looking at the 1931 show

A résumé of what was to be seen at Detroit last month

CONCENTRATION of the year's aircraft displays into a single exposition of major proportions seems to have had a desirable effect, as indicated by the reaction of the exhibitors who participated in the National Aircraft Show, April 11-19 at Detroit City Airport. This display is the fourth of a series held at Detroit each April and was sponsored jointly by the Detroit Board of Commerce and Aeronautical Chamber of Commerce.

Decorative effects in the booths and settings for the major exhibits in general expressed ingenuity and artistic value surpassing any of the previous aeronautical expositions.

As in the 1930 Detroit show, one of the most attractive exhibits was that sponsored by the Ford Motor Company, airplane division. This, together with the Fokker offering occupied the major portion of the sub-division of the hangar nearest to the field. The Ford exhibit centered about a giant plaster figure supporting on its shoulder one of the three airplanes constituting the exhibit. Some difficulty was experienced, however, when it became desirable to change airplanes and it was necessary to amputate the Herculean hands at the wrist to make the substitution. The Fokker exhibit also included three airplanes, in a garden-like setting.

An especially elaborate exhibit was that offered by the Pitcairn Company, featuring the autogiro. One of the smaller machines of this type was placed in a stage-like setting in a corner of the hangar and this unit was flanked by wall exhibits involving elaborate mechanical devices to show the comparative performance of the autogiro and the normal airplane.

Engine and accessory exhibits were on a considerably higher plane than those of some of the earlier shows, though some of the manufacturers used essentially the same exhibit material as last year as a measure of economy.

By accident or design there were several accessory exhibits that seemed to have been conceived in pairs. The structural framework of the Dow Chemical display was almost perfectly matched with that of the Goodyear-Zeppelin Corporation, while the R.C.A. and Breeze exhibits were decidedly supplementary. The actual representation of personnel of the industry was probably more complete than at any similar event in the past.

More novelty exhibits

Novelty exhibits, calculated to amuse or mystify the casual visitor were somewhat more numerous than in the past indicating a growing belief that the general public constitutes the bulk of attendance. Indication of a higher level of intelligence was observed by a number of the exhibitors based on the types of questions they were called upon to answer, but the level is still considerably below that of current automobile and marine equipment shows. A large part of the show attendance still forms a vapid crowd, drifting open-mouthed from one exhibit to the next.

A report of the management issued following the show states that 636 airplanes and two gliders were sold by seventeen companies. No distinction is made between machines actually sold to individuals and those allocated to dealers or distributors. The attendance during the nine days totaled 90,000.

Outstanding from a merchandising standpoint was the series of price re-

ductions, beginning with the Stinson "Junior" on the first day of the show. The "Junior" price came down from $5,995 to $4,995. Early Monday morning the Great Lakes Aircraft Corporation announced a reduction of $200 in the price of the "Sport Trainer," bringing it down to $2,985. Later in the day a reduction of $1,775 was made in the price of the Challenger-powered Curtiss-Wright "Sedan," the new figure being $4,595. The price with the Kinner engine has been reduced to $5,100. The announced belief, and the very real hope, are that the new low prices will increase the range of the prospect group and permit a greater production volume.

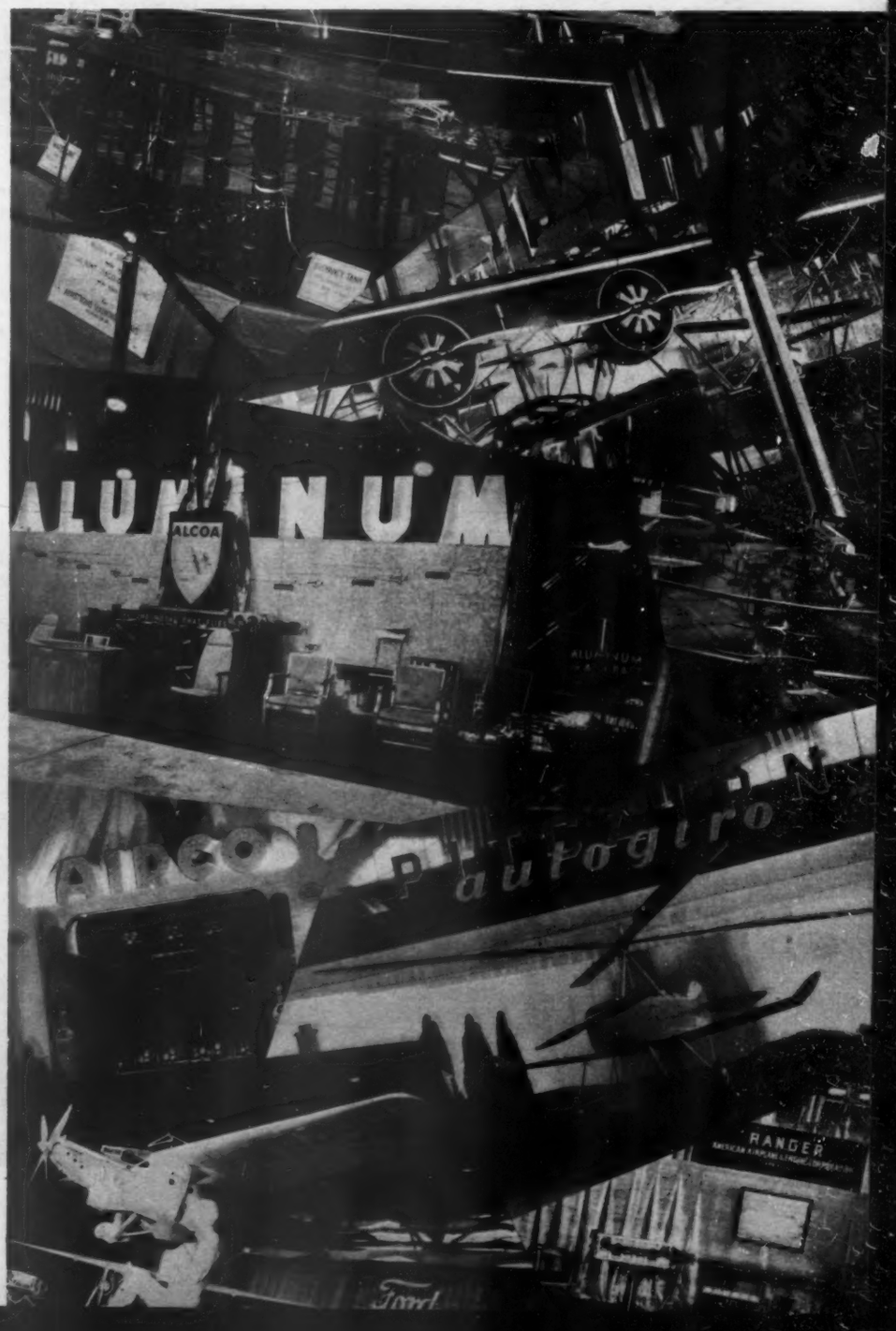
Some dissatisfaction was expressed by exhibitors at the date of the show and at a meeting of the show committee of the Aeronautical Chamber of Commerce it was decided that next year's exhibit would be held not later than the second week in February. Proposals were received from Indianapolis, St. Louis, and Kansas City for the 1932 show, and from New Orleans for the 1933 exposition.

Most impressive among the special events taking place during the show was the memorial service conducted in connection with the unveiling of the tablet to Capt. Lionel M. Woolson, designer of the Packard Diesel Aircraft engine, killed in a crash a year ago.

That a week of continuous demonstration and miscellaneous flying of every sort came to an end without any serious accident proves both a great deal of careful thought by the management and a substantial measure of good luck. There have no doubt been previous occasions, during military maneuvers or air races when the Detroit record of 114 landings and 95 take-offs in an hour has been equalled. We can find no previous record, however, of such long-continued intensive use of an airport, with more than 10,000 take-offs and landings in a little more than a week. From shortly after dawn till long after dark, the field was kept busy.

To minimize the collision danger no plane was supposed to leave the ground until it had been flagged away by a starter, and the runway was reserved for taking off, with the area on one side of the runway for landings and that on the other side for taxiing to the take-off point. After landing, each machine was supposed to taxi clear down to the windward end of the take-off runway before crossing it into the area where it could turn to taxi back to the starting-point for another flight. The system was as near ideal as any that has ever been developed. The starters knew their business and got the planes away in as rapid succession as safety permitted, and there was no trouble on the runway except occasionally when two machines landed too close together and on converging paths.

The trouble came elsewhere. To permit of still more flying, and to save the time that would be required by such types in taxiing the whole length of the field and back after every flight, the autogiro and certain of the light planes were allowed to take off across the cross-wind runway. So long as they adhered to that specification all was well, but occasionally when the wind was light a pilot would grow absent-minded and get off along the runway instead of across it. His course then cut straight across the main line of traffic and more than one pilot was horrified on coming in to land to discover that he was face to face with a light plane apparently intent on sitting in his lap before he could get onto the ground. The hazard of this doubling of the operations was too great to be accepted, especially where there is no



A general impression of the show and brief discussions of the aircraft, engines, and accessories exhibited

code of signals for communicating with planes in the air. In the future take-offs should be rigorously limited to one at a time, even though certain types of planes may have to go to another field for their demonstration. Conditions were unsatisfactory for the autogiros in any case, as safety required that they be flown along in the general traffic lines very much like airplanes. Vertical descent across the path of an endless succession of on-coming machines would have been far too dangerous to be practiced with any frequency.

One factor of congestion that could well have been eliminated was the hop business. While it may have persuaded into the air a considerable number of casual visitors to the show who had never flown before, any good that might have been accomplished in that way was more than offset by the unattractive aspect of a number of men, most of them clad in extremely dirty white overalls, marching up and down and hawking three-dollar tickets. The frequent arrival of transport machines, with neatly uniformed pilots and brisk and efficient ground crews to receive them, was an admirable supplement to the efforts of the salesmen demonstrating new machines to prospective customers. The joy-riding activity was, to put it conservatively, of negligible assistance.

Aircraft

AERONAUTICAL engineering progress during the past year, as measured by a study of the aircraft exhibited at the National Aircraft Show last month, has been somewhat slower than expected by many who visited Detroit. Design progress, however, is of two varieties, one the refinement of existing machines and the other the creation of new and more unusual types. With respect to the last of these, the 1931 offering was richer than any that has been held for a number of years, for this exposition marked the introduction of the public of such unusual machines as the Pitcairn-Cierva Autogiro and the Stout "Sky Car." Just as the Packard Diesel aircraft engine attracted thousands of interested spectators at last year's Detroit show, so the autogiro and the "Sky Car" were centers of attraction during the most recent presentation. Low priced light airplanes of the one and two seat variety abounded.

Numerical study of planes

From the comparative numerical study of the airplanes at the Detroit show of 1929, 1930 and 1931 (see table below) certain design trends are evident. First the steady increase in the proportion of monoplanes, which in the most recent Detroit show represented 68 per cent of the exhibited machines. There have been no convertible monobiplanes since the R.S.V. which was shown at the 1929 Detroit show, and the sesquiplane type has decreased from four to one per cent in the two year period. Even the Sikorsky amphibion, which was for such a long period a sesquiplane, has become a pure monoplane in the S-41 version. A system of struts tying in the wing float with the monoplane bracing has been substituted for the stub wings of earlier Sikorsky models.

Despite the large number of light planes the proportion of open machines was considerably less than at last year's exposition. It is quite obvious that the manufacturers feel a predominant demand for closed machines, particularly in the medium weight group.

The cabin biplane type has always been in the minority, but is usually represented by at least one new design at every aeronautical exposition. In the present instance, the latest addition to the Waco line, powered by the new Continental A-70 radial, was one of the features.

While our numerical study breaks down at the point where we consider the proportion of land planes and seaplanes because of the fact that exhibition of a machine on floats is largely a matter of arbitrary choice, the figures will serve to approximate the industry's general view of popular interest. Upon that score, the increase in available machines having float equipment becomes significant. At the present time a very large number of standard airplanes have been approved by the Department of Commerce for float equipment and this number is scarcely reflected by the percentage of machines exhibited on floats in any aircraft show. In spite of this obvious weakness, there has been a decrease in proportion of approximately 9 per cent in land planes from last year's figure. The number of land planes has suffered partly because of the increase in amphibious, from 2 to 8 per cent during the two year period. In this connection, it is a pleasure to observe that all of the amphibions in the 1931 show were very creditable designs with no appearance of hasty improvision.

The Stinson and Douglas machines are new, while the Sikorsky, American Aeronautical, Amphibion "Privateer," and Keystone Loening offerings were familiar. Both of the new machines are monoplanes with twin engines, the Stinson power plant units being streamlined into the upper surface of the wing while the Douglas engines are mounted considerably above the wing and the two units connected by an auxiliary streamlined surface.

The presence of the twin-engine am-

Comparative statistics of the Detroit shows

	Detroit Show 1929		Detroit Show 1930		Detroit Show 1931	
	No.	Per Cent	No.	Per Cent	No.	Per Cent
Total planes entered*	100	..	75	..	75	..
Monoplanes	48	48	45	60	51	68
Biplanes	47	47	29	39	23	31
Convertibles	1	1	0	0	0	0
Sesquiplanes	4	4	1	1	1	1
Low-wing	6	6	7	9	10	13
Center-wing	3	3	0	0	4	5
Folding-wing	7	7	1	1	2	1‡
High-wing	39	39	38	51	28	38
Parasol					9	12
Tractor	†	†	†	†	71	95
Pusher	†	†	†	†	4	5
Open planes	53	53	47	63	43	57
Closed planes	47	47	28	37	32	43
Land planes	95	95	68	91	62	83
Seaplanes, flying boats	3	3	3	4	7	9
Amphibions	2	2	4	5	6	8
Single-engined	95	95	67	89	69	92
Twin-engined	1	1	2	3	3	4
Three-engined	4	4	5	7	3	4
Four-engined	0	0	1	1	0	0
One-place	4	4	2	3	13	17
Two-place	32	32	28	37	31	41
Three-place	29	29	13	17	5	7
Four-place	11	11	12	16	8	11
Five-place	5	5	0	0	1	1
Six-place	9	9	9	12	3	4
Seven- and eight-place	7	7	6	8	9	12
Nine-place or more	3	3	5	7	5	7
Radial-engined planes	90	90	59	79	56	74
Vertical in-line air-cooled	10	10	5	7	5	7
Inverted in-line-cooled	..	..	2	3	8	11
Opposed	..	..	1	1	5	7
Water-cooled (excl. OX-5)	..	..	0	0	1	1
Diesel	..	..	6	8	0	0
OX-5	9	9	2	3	0	0
0-50 hp	3	3	2	3	12	16
51-150 hp	50	50	26	35	28	37
151-200 hp	14	14	4	5	5	7
201-300 hp	11	11	15	20	4	5
More than 300 hp	27	27	28	37	26	35

* Table does not include three Autogiros exhibited by Pitcairn Aircraft, Inc.
† No classification available.
‡ Included in high-wing classification.

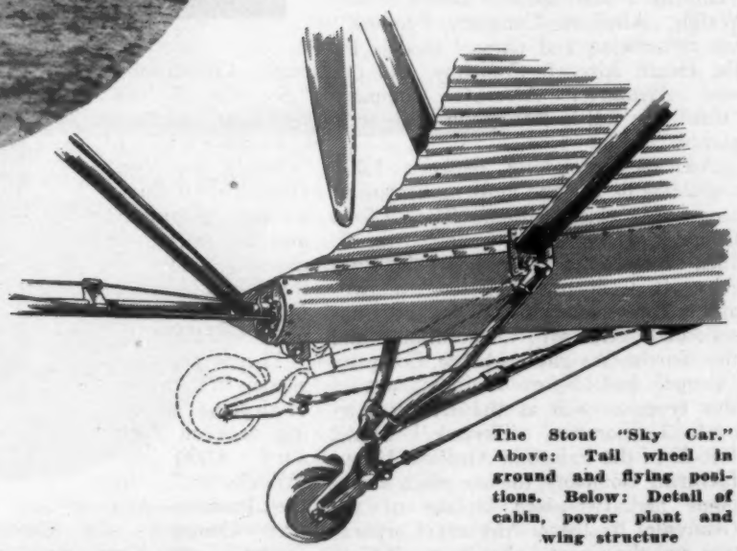
Pitcairn sport Autogiro

phibions has brought the proportion of bi-engined machines to a somewhat higher point than before, while that of single-engined planes has also increased slightly at the expense of the three-engined type, which fell from 7 to 4 per cent since last year. The rise of the single-engined transport is obvious, and much comment was occasioned by the fact that only single-engined machines were exhibited by the Fokker Aircraft Corporation. The Fokker F-14, the Ford Express Plane, the Bellanca "Air Bus," and the Lockheed "Orion" are examples of the more recently developed single-engined transports.

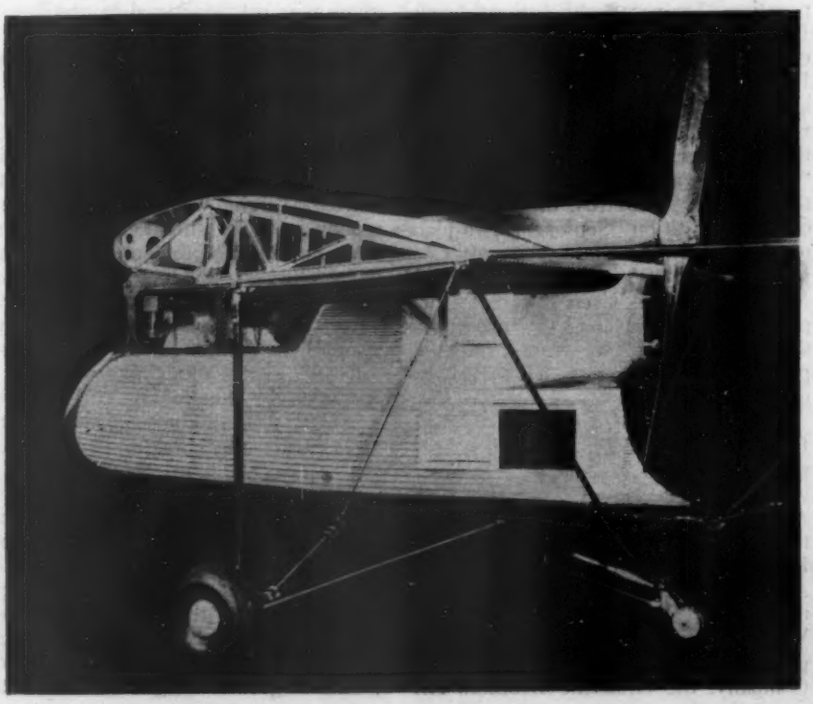
There was a six-fold increase in airplanes of the single-seat variety as compared with any previous show. Thirteen of the 75 airplanes on the exhibition floor were single seaters. This variety seems to have gained increased popularity at the expense of the familiar three-place open cockpit biplane, which shows a decrease from 29 to 7 per cent since 1929. Constant, through very gradual gains, are noted in the two-place type, which accounted for 41 per cent of the machines at the recent Detroit show. Eight machines of four-place capacity were shown, and these should prove somewhat more popular in the forthcoming season, for it was in this group that the drastic price reductions were made. Five- and six-place machines have suffered losses, and those with seven or more seats show some gains in spite of the scarcity of tri-engines.

Eighteen per cent of the machines at the show were powered with vertical or inverted-in-line air-cooled engines and the streamlining possibilities, particularly of the inverted type, makes the installation a very attractive one. Four per cent of the machines had two-cylinder opposed power plants, while the Ford plane with Hispano-Suiza engine was the first machine with a liquid-cooled engine that has been presented at a major exhibit since St. Louis in February of last year. There were no Diesel-powered machines on the exhibition floor. There were no OX-5s, and that marks the end of a era. This was the first show since 1918 from which war material was entirely absent.

As might be expected there was an increase of 3 to 16 per cent since 1929 of airplanes having engines rated at 50 or less hp. This was balanced somewhat by a decrease from 50 to 37 per cent of machines in the 50 to 150 hp. range indicating a trend toward lower



The Stout "Sky Car." Above: Tail wheel in ground and flying positions. Below: Detail of cabin, power plant and wing structure



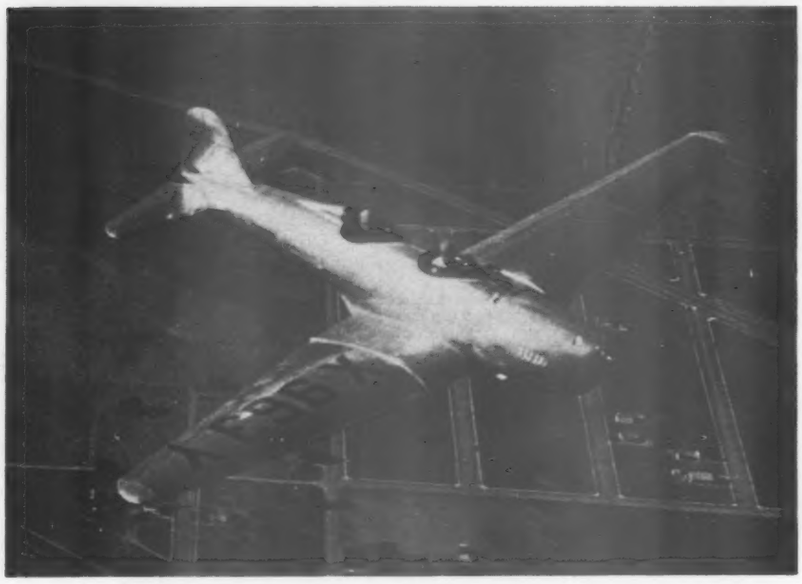
horsepower per passenger. Losses were also sustained in the range from 150 to 300 hp., but a gain of 8 per cent is noted in machines having power plants of greater rating than 300 hp. Only two of the machines exhibited had folding wings, a feature which British public opinion demands but to which America seems to be either indifferent or hostile.

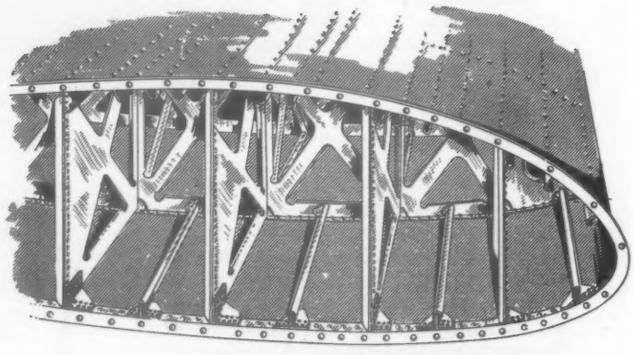
Classification by weight

The airplanes exhibited at the Detroit show have been classified according to certain arbitrary groupings by weight. The group of planes of 1,000 lb. or less included both one and two place models of the Aeronca by the Aeronautical Corporation of America, the American Eagle Aircraft Company "Eaglet," the Alexander Aircraft Company "Trainer," and both land and seaplane models of the Buhl Aircraft Company "Bull Pup." The Curtiss-Wright Airplane Company "Junior," the centerwing and parasol models by the Heath Aircraft Company, and the new Alexander Aircraft Company "Cub" also fall in this group of lightest planes.

Airplanes weighing between 1,001 and 2,000 lb. are the most numerous of any single classification. The "Cloud Coupe," of the Cloud Coupé Aircraft, Inc., a newcomer in the field; the Buhl Aircraft Company "Airster," a two- and a three-place "Fleet" by the Consolidated Aircraft Corporation, and the Curtiss-Wright Airplane Company "Coupé" and "Sport Trainers" are of this type, as well as the Driggs Aircraft Corporation "Skylark," Model KR-22 of the Fairchild Airplane Manufacturing Company, the one-place monoplane and two-place biplane of the Granville Brothers Aircraft Corporation and the Great Lakes Aircraft Corporation "Trainers." "Solution," by the E. M. Laird Airplane Company, two closed models by the Mono Aircraft, Inc., the Nicholas Beazley "Trainer" and other two-place model, the Northrop Aircraft Corporation "Beta," and the Paramount Aircraft Corporation "Sportster" are of this weight, as are the Pitcairn Autogiros, the Sioux Aircraft Corporation "Senior," a two-place monoplane by the States Aircraft Corporation, the Stout "Sky Car," and Model F by the Waco Aircraft Company. A late arrival in this group was the Cain monoplane, a parasol type, powered with a Cirrus "Hi-drive" engine.

In the group of airplanes weighing from 2,001 to 3,000 lb. are the three-place amphibion biplane of the American Aeronautical Corporation, the Amphibions, Inc., "Privateer," the three- and four-place biplanes of the Bird Aircraft Corporation, the Boeing Airplane Company pursuit plane, and the Deluxe "Sportsman" by the Curtiss-Wright Airplane Company. The four-place seaplane of the Detroit Aircraft Company, the Granville Brothers Aircraft Corporation "Senior," the Swanson Aircraft Corporation "Coupé," the Verville Aircraft Company "Trainer," and the open and closed biplanes of the Waco Aircraft Company are also of this weight.





Wing structure of the Northrop "Alpha." Above: The Northrop "Beta" (Menasco "Buccaneer") in flight

There are five models in the group of airplanes weighing between 3,001 and 4,000 lb.: "Witchcraft," by the Buckley Aircraft Company; the Curtiss-Wright "Sedan"; the Ryan six-place monoplane now manufactured by the Detroit Aircraft Corporation; and the two four-place monoplanes made by the Stinson Aircraft Corporation.

Airplanes in the 4,001 to 5,000 lb. class are more numerous. They include the Bellanca Aircraft Corporation "Skyrocket" and "Pacemaker," the Curtiss-Wright "Commuter"; the Vega monoplanes of the Detroit Aircraft Corporation in both land and seaplane models, the Northrop Aircraft Corporation "Alpha," the Stearman Aircraft Company single-place biplane, and the Amphibion exhibited by the Stinson Aircraft Corporation.

Models by the Fokker Aircraft Corporation, two eight-place monoplanes and a seven-place amphibion, dominate the 5,001-7,500 lb. group, which also includes an eight-place "Fleetster" by the Consolidated Aircraft Corporation, and the Detroit Aircraft Corporation's "Orion."

The Bellanca "Airbus," the Douglas "Dolphin," and the Stinson nine-place monoplane complete the list of planes weighing up to 10,000 lb. Only four planes of greater weight were exhibited, two airliners and a freighter by Ford Motor Company and a sixteen-place Sikorsky amphibion.

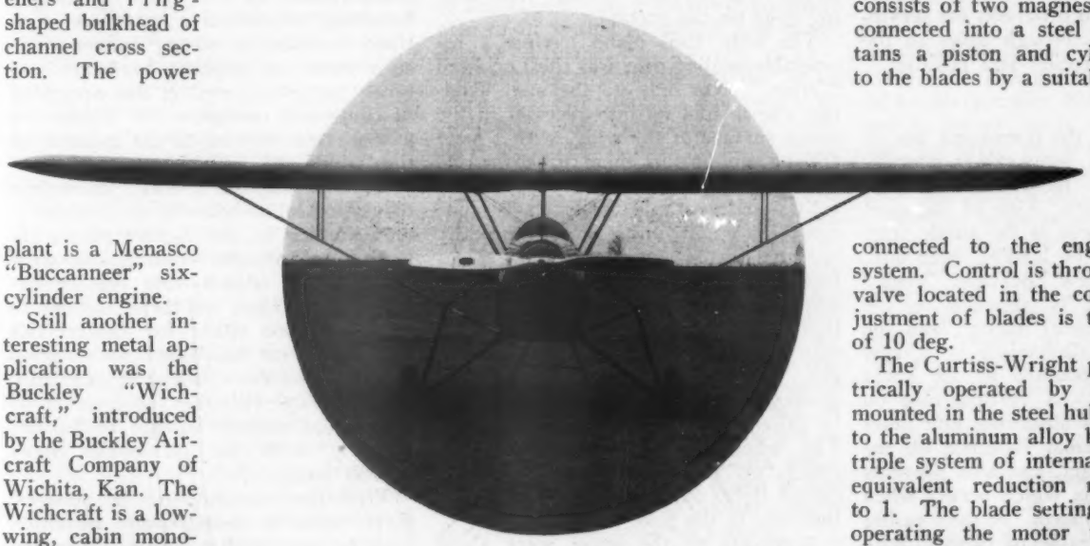
General design tendencies

Progress has been slow in the transition from wood to metal in airplane construction. This trend, so noticeable last year, gave evidence of very little advance and with one or two exceptions the situation remained unchanged. One significant departure, however, is the use of stainless steel in airplane wing rib constructions, as exemplified by Amphibions' "Privateer." In contrast to the European practice of riveting this material, the "Privateer" wing rib is built up of stainless steel, spot welded in a special machine developed by Fleetwings, Inc.

One of the most promising developments from a quantity production viewpoint is the application of metal semi-monocoque construction to light plane construction, notably to the Buhl "Bull Pup." The fuselage of that machine is constructed entirely of metal. Three longitudinal members of flanged vee-section provide rigidity, while a very large proportion of the stress is carried

by the sheet metal covering. Longitudinal members are steel from the nose or engine mounting bulkhead to a point behind the cockpit, and from there to the tail are of aluminum alloy. Small diameter steel tubes are welded to the longitudinal members forward of the cockpit to provide reinforcement and transverse bracing.

A late arrival in the show, the Northrop "Beta" is another example of the application of metal construction to the relatively light airplane. The "Beta" is built entirely of metal, with a fuselage of the skin-stressed type and a wing having the same structural principles as the Northrop "Alpha." The fuselage has an Alclad skin with integrally formed longitudinal stiffeners and ring-shaped bulkhead of channel cross section. The power plant is a Menasco "Buccanneer" six-cylinder engine.



The "Rover"-powered Fairchild KR-22 monoplane

Still another interesting metal application was the Buckley "Wichcraft," introduced by the Buckley Aircraft Company of Wichita, Kan. The Wichcraft is a low-wing, cabin monoplane built entirely of metal, but somewhat more nearly conventional in construction than those previously described.

Marking the return of the Ford Motor Company aeronautical division to single-engined airplane production, was the introduction of an all-metal express carrying machine, powered with the 650-hp. Hispano Suiza engine. While the new Ford plane was constructed entirely of metal, it is noteworthy that a four-bladed wooden Hartzell propeller was employed to obtain best results from the engine which has a two to one gear ratio. The Stout "Sky Car" was also a member of the all metal group, using corrugated duralumin covering and other features characteristic of designs previously developed by Mr. Stout.

Structural methods

Development in the use of metal was also apparent in exhibits other than those of airplanes. A hollow steel propeller which was introduced during its early stages of development at the Detroit show of 1929 was shown in advanced form by the Pittsburgh Screw and Bolt Corporation, and there were rumors of other steel propellers on the horizon, although no others were actually shown. The Dicks propeller seeks an increased blade efficiency by discharging air through apertures in the back of the hollow blade near the trailing edge. The air is taken in at the hub, and the effect is to reduce "burbling" at large angles of attack. The action is essentially the same as that of a slotted wing. After a long period of development, these propellers are now in production.

A one-piece aluminum alloy propeller was shown by the Curtiss Aeroplane and Motor Company. Blades and hub are forged integrally, the latter being exceptionally small, permitting blade losses toward the hub to be somewhat reduced. The weight is said to be comparable to that of a wooden propeller. Magnesium propellers were exhibited by the Hamilton-Standard Company.

A study of the propeller equipment on exhibited machines revealed 52 of the metal type (of which 45 were adjustable pitch and seven fixed pitch). Twenty-five were of wood, out of a total of 78.

After a number of years of effort to produce a satisfactory variable-pitch propeller, two models were offered at the show. Both have been flight tested, and are now available commercially. They are alike in that the effective pitch is changed by varying the angularity of the blades with respect to the hubs, and in that mechanical power is used instead of manual effort to do the work, but the result is accomplished by radically different methods.

The controllable pitch propeller exhibited by the Hamilton Standard Propeller Company of Pittsburgh, Pa., consists of two magnesium alloy blades connected into a steel hub which contains a piston and cylinder connected to the blades by a suitable linkage. The angularity of the blades is controlled by oil pressure in the cylinder which is connected to the engine lubricating system. Control is through a three-way valve located in the cockpit. The adjustment of blades is through a range of 10 deg.

The Curtiss-Wright propeller is electrically operated by a small motor mounted in the steel hub, and connected to the aluminum alloy blades through a triple system of internal gearing of an equivalent reduction ratio of 27,000 to 1. The blade setting is adjusted by operating the motor from a control switch on the instrument board. The available range of adjustment is a full 360 deg.

The ring or Venturi type of cowling gained predominance for the first time at an aircraft show. Of 60 airplanes having radial engine cowlings, 25 were plain, 22 of the ring type and thirteen of the N.A.C.A. variety. Except in cases where the fuselage is particularly adopted to a Venturi or N.A.C.A. cowl-

Waco cabin biplane with Continental A-70 engine

ing, as in the Lockheed, the ring type is in most common use. Some of the most recent rings are particularly designed for quick detachment in maintenance operations. This type was represented by the Curtiss anti-drag ring, one of the most recent developments of the Curtiss-Wright Company, which is being offered for all standard radial engines. The Curtiss ring consists of a simple band of curved sheet metal about a foot in width, having padded supports to rest on each rocker-box of the engine cylinder. No built-up supports or mounting brackets are necessary, and the only operation required to attach the ring is the tightening of turnbuckles.

Another type of cowling is that supplied with the Jacobs aircraft engine, rigidly attached with integral exhaust manifold, but with provision for servicing rocker arms through holes in the cowling at each rocker-arm position.

Landing gears

As a result of the increasing use of low pressure tires, some rather interesting developments have been made in landing gear design. One of the most noteworthy of these is the single strut wire-braced type of landing gear unit, installed on the new Lockheed "Vega." The single strut is attached to the fuselage in the usual manner and the shock absorber mechanism is a new Oildraulic unit mounted at the lower end of the strut. A vertical tube on either side of this absorbing unit takes care of the torsional influence on the first landing impact, and also prevents the turning motion which occurs when the brakes are applied. A steel casing carries the brake cable, of Bowden wire type, and permits of the travel of the absorber without affecting the efficiency of the brake cable. A fairing completely encloses the shock absorber, producing a general form which may well offer less air resistence than would the wheel alone.

Other interesting landing gears of the oleo type were shown on the Fleet and Waco airplanes, and their exceptionally clean design has been made possible partly by the relatively low shock-absorber travel required with low-pressure tires. Both of these landing gears are of the rigid type, with shock-absorber units built into the main struts and having a travel only sufficient to supplement the cushion effect of the air wheels. Several airplanes of the lighter groups were fitted with low-pressure tires in completely rigid mounting.

The landing gear of the "Sky Car" is unique in that it is of the four-wheel type. The main weight of the machine is carried by two airwheels hung on struts from the wings, located approximately in the plane of the center of gravity of the airplane. An adjustable tail wheel supports the machine in level position on the ground, but retracts automatically in conjunction with the elevator control to permit the tail to drop into take-off position when the stick is pulled back. The wheel remains in the retracted position during flight and in landing, may be pulled down to level up the fuselage for taxiing by pushing well forward on the stick. A small wheel faired into the under side of the nose prevents damage from nosing over on the ground.

The only land plane having a retractable landing gear was the Lockheed "Orion." Not only do the main landing wheels fold up into recesses in the under surface of the wing, with a plate coming up behind them to cover the aperture, but the tail wheel may also be fully withdrawn into the fuselage. The control for all units is hydraulically operated from a pump and valves located in the fuselage. The tail wheel, when extended, is steerable in connection with the rudder, and, in addition, it may be released to caster through 360 deg. to facilitate handling on the ground. The entire landing gear may be raised in 35 sec., lowered in 10 sec. The wheels are automatically locked either "up" or "down," and a system of signal lights on the instrument board indicates to the pilot their position.

Airplanes at the show were about equally divided between tail wheels and tail skids and the number of planes equipped with steerable tail units seems to be on the increase. In the amphibion planes, the tail wheels are frequently used as water rudders and for this purpose a flat-sided solid rubber tire resembling a disc, rather than a pneumatic tire, seems to be the preferred form.

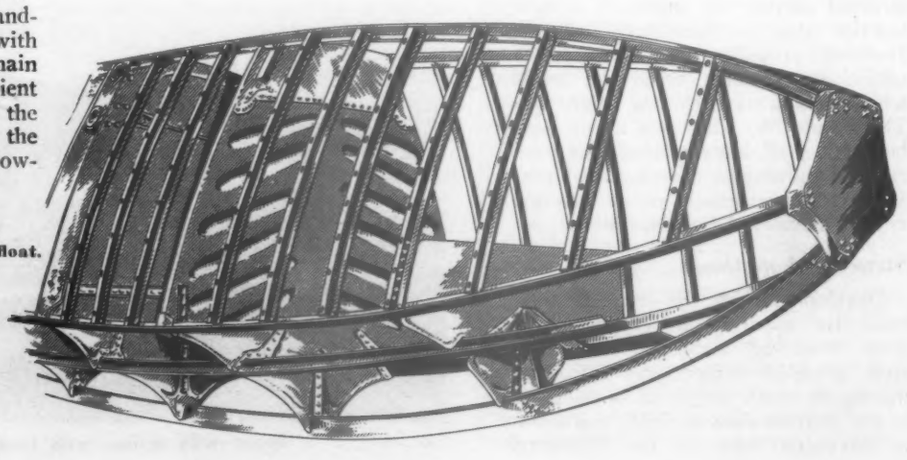
Only eleven of the 63 land planes in the show were equipped with wheel fairings. Of the total of 78 airplanes, 53 had brakes, 56 had dual control, and rudder pedals were universally used. Sixty-one of the 78 had stick controls, while the remainder were of the wheel type.

Interiors and other matters

Sleeping accommodations in airplanes were represented on the special custom built S-41 Sikorsky, sold for the personal use of E. W. Backus, western lumberman. Airplanes considered for similar service, but not having sleeping accommodations, were exhibited by the Ford and Stinson Companies. Particularly elaborate interior decorations were notably lacking in the cabin machines, and by far the majority were characterized by simplicity in internal finishing. Automotive practices continue to exert a strong influence on such items as airplane hardware and other specialties used in the equipping of cabin and cockpit. The automotive analogy was carried to the extreme in the "Sky Car," with the obvious intention of causing the average automobile driver to feel at home in an airplane.

A number of the lighter planes intended for popular consumption were designed for side-by-side seating arrangement. Most of them seemed to have sufficient space for comfortable seating. There has been some question as to whether this could be accomplished satisfactorily with the preservation of a fuselage narrow enough to balance properly with the necessarily short overall length.

With the exception of the autogiro there were no aerodynamic novelties, such as variable lift devices. Leading edge wing slots and trailing edge flaps were conspicuous by their absence. Two of the machines, however, had devices to substitute the conventional stabilizer adjustment. Of these the trimming strut mechanism of the Ireland "Privateer" has been described [AVIATION, December, 1930]. The substitute for stabilizer adjustment was evolved by Ralph Upson for the Stout "Sky Car." This arrangement is controlled



Bow framing of new 30-deg. vee-bottom Edo float.

by a knurled knob on the upper end of the stick and changes the angle of the elevators with respect to the fixed stabilizer at the neutral position.

An interesting brake control system was shown on the Swanson Coupé. This control was a hand lever having a universal mounting and making it possible to control either or both brakes while taxiing. A throttle booster button is fitted in the head of the control lever which also facilitates ground handling.

Engines

NEW design gives evidence that considerably more attention is being paid by engine designers to the problem of maintenance than in the past. In addition to the large number of refinements in detail, practically all of which tend toward decreased specific weight, several trends are noticeable. One of the most significant is the revival of the two-stroke-cycle type engine. Several major manufacturers who have been concentrating on larger radials are now adding two-cylinder opposed two-stroke engines to their line for use with light single-seat airplanes, and one diminutive engine of this type for glider installation was shown. The obvious advantage in the two-stroke for low-power engines, where low cost and low weight are equally important, makes it a very attractive development. The movement might be considered as comparable in some degree to the increase in use of outboard engines in the marine field.

The Aeromarine Plane & Motor Company of Keyport, N. J. exhibited a new 40-hp. air-cooled radial engine designed for use in light airplanes.

An experimental two-stroke radial air-cooled engine said to develop 150 hp. at 2,000 r.p.m. was exhibited by the Hurricane Aviation Corporation of Houston, Tex. The absence of valve gear afforded exceptionally clean cylinder heads and minimum overall diameter. An unusual feature of the design is the plan to discharge the exhaust gases through the trailing edges of a hollow steel propeller with a special spinner which serves as a collector. Improved scavenging action, and some noise reduction is claimed for this device.

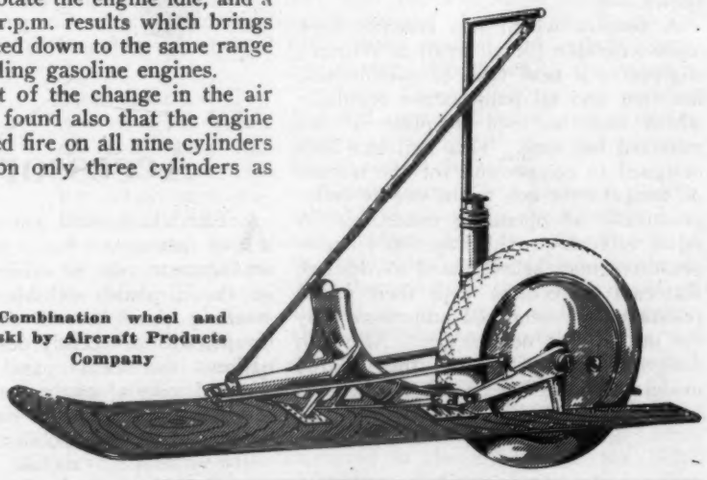
Despite the handicap occasioned by the loss of Captain Woolson, remarkable progress has been made in refinement of the Diesel cycle engine by the Packard Motor Company. The 1931 model retains the principal characteristics of the original design, but incorporates certain improvements which were found to be necessary as a result of considerable flight testing in single- and multi-engined airplanes.

With the original design the idling speed of the engine in a glide was considerably greater than that of a corresponding gasoline type. This resulted in decreased over-all drag and a tendency for the airplane to "float," requiring greater space in which to land, but by changing the air intake valve from a butterfly to a barrel type the difficulty has been overcome. The valves are interconnected with the throttle control in such a way that the free flow of air into the cylinder is considerably restricted, resulting in the formation of a partial vacuum toward the end of each intake stroke. More power is then required to rotate the engine idle, and a reduction in r.p.m. results which brings the idling speed down to the same range as corresponding gasoline engines.

As a result of the change in the air valve, it was found also that the engine at idling speed fire on all nine cylinders rather than on only three cylinders as was the case before the valve mechanism was changed. This results in better acceleration, both on the ground and in the air, as it eliminates the lag that formerly existed before the remaining six cylinders started firing after the throttle was opened.

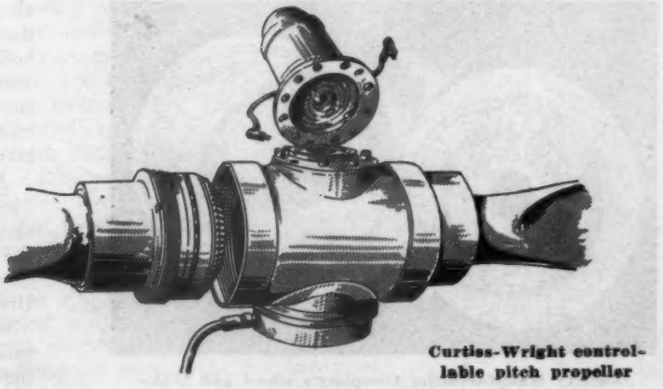
Another improvement in combustion efficiency was effected by a change in the contour of the piston head. The compression ratio was reduced from about 20:1 down to 14:1. These changes resulted in an improvement in fuel economy, and it was found that to retain the rated power and speed

Lockheed single strut landing gear



Combination wheel and ski by Aircraft Products Company

Solid tail wheel and centering device of Sikorsky S-41



Curtiss-Wright controllable pitch propeller

(225 hp. at 1,950 r.p.m.), the stroke of fuel pump could be decreased about 15 per cent. The specific fuel consumption then decreased about ten per cent. On the present piston an additional oil ring was fitted to control more adequately the oil flow over the thrust surface. These two changes eliminated all smoke from the exhaust at cruising speed, leaving but a trace of smoke at wide-open throttle.

A New Diesel

A recently designed engine of the Diesel type was shown by the Guiberson Corporation of Dallas, Tex. A Waco biplane with one of these engines installed was flown during the show. The engine is a nine cylinder radial resembling the ordinary gasoline type in outward size and appearance. Structural details were not available.

A newcomer in the light engine field was the Poyer 3-40, manufactured by the Poyer Aircraft Engine Company of Kansas City, Kan. It is a three-cylinder four-cycle air-cooled engine, developing 45 hp. at 2,500 r.p.m.

Six engines, representative of its entire line, were exhibited by the Pratt & Whitney Aircraft Company. These included the various models of the 300 hp. "Wasp Junior," the well-known "Series C-Wasp," and the "Hornet." One "Hornet" had been subjected to a 300-hr. run at 660 hp. at 2,100 r.p.m. Various engine parts and a display of photographs featuring their manufacturing methods and facilities were also shown.

A feature which has recently been made available for all Pratt & Whitney engines is a new type of combination hot spot and oil temperature regulator which may be used in place of the standard hot spot. This unit has been designed to compensate for the normal oil temperature rise to the engine under practically all operating conditions. A relief valve is provided so that oil temperatures may be regulated as desired. External oil coolers with their added resistance are rendered unnecessary by the use of this new device. Although designed primarily for the geared models and the "Series B Hornet," it may be very readily installed on all other engines.

Eleven engines were exhibited by the Wright Aeronautical Corporation of Paterson, N. J., three of which were cut away and operating, and two of which were of historic interest.

The new "Model E Whirlwind" is fundamentally the same as its predecessors but includes certain improvements, such as a band type clutch in the supercharger drive, revision in rocker arm lubrication, redesigned cylinder heads with increased cooling area, and the new spark plug coolers. The latter consist of bronze inserts of standard design, cast into aluminum alloy cups which are heavily tinned on the outside for cooling. Ignition wire terminals completely enclosing the spark plugs are attached to the end of each wire, and not only protect the plugs from the elements but adapt the engines to complete radio shielding. As a result of cylinder head changes and of spark-plug coolers, the "Cyclone" has 50 per cent more available fin area and the "Whirlwind" 40 per cent more than their immediate predecessors.

Exhaust rings of the tangential type are furnished as standard equipment with each Whirlwind Model E.

Refinement of detail, rather than radical changes in design over equipment previously known, characterized the exhibits of the American Airplane and Engine Company (formerly the Fairchild Engine Company), Lycoming Manufacturing Company, Glenn L. Martin Motors Company (formerly the Chevrolet Engine Company), and the Szekely Aircraft and Engine Company.

Oil cooler for Pratt and Whitney "Wasp" and "Hornet" engines

Accessories

A TREND toward automobile styles of instrument board and accessory arrangement was in evidence on many of the airplanes exhibited. An outstanding example was the Kari-Keen Coupé, with a recently designed combination instrument panel which resembled very strongly the boards now used on most automobiles. The automobile analogy had also been pursued in the Stout "Sky Car," both on the instrument board and in the use of a button underfoot for the starter.

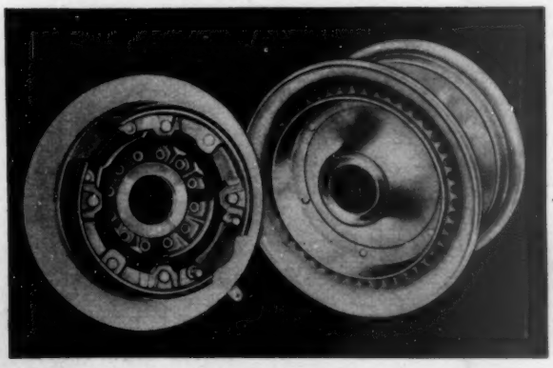
Among the individual concerns showing instruments the Pioneer Instrument Company of Brooklyn, N. Y., exhibited several new units, including their new "Tele-point" compass, a remote reading magnetic type with course-setting control and course indicator resembling the earth inductor types; a drift meter to be mounted in the floor of a cockpit which focuses an image of the ground on a glass screen and gives a reading of the true angle of flight with reference to the earth; a compact octant of rugged design; and a performance test set developed for the government.

The General Electric Company exhibit included electric tachometers and their new electric bank and turn indicator, built around a remote-reading gyroscope and indicating the direction and approximate rate of turn. The same basic device was shown also as a turn compensator for use with their magneto compass, its purpose being to correct for the so-called "northerly turning errors" common to all types of magnetic compass.

Other accessory exhibits included the "Moto-Vita," an indicator of the degree of engine combustion, designed by Dr. M. R. Hutchinson and developed by the Moto Meter Gauge and Equipment Corp., of Toledo, Ohio. [See AVIATION for January, 1931, p. 57.]

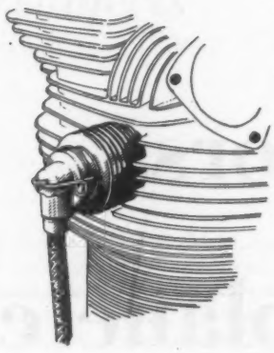
Three new spark plug designs were exhibited of which the copper-cooled H-T plug manufactured by the Hurley-Townsend Corporation of New York was the most radical in construction. This plug has a copper sleeve surrounding the center electrode, with the object of maintaining lower electrode temperatures by making use of the higher heat conductivity of the copper. Walter Kidde & Company showed a completely shielded plug known as the Hahn, and the AC Spark Plug Company, the Champion Spark Plug Company, and the B-J Company exhibited their regular line of aircraft plugs.

Airport lighting equipment and accessories were included in the exhibits of the General Electric Company, Westinghouse Lamp Company, Westinghouse Electric and Manufacturing Company, The American Gas Accumulator Company and the Pyle-National Company. The Michigan Bell Telephone Company exhibited a complete teletype system such

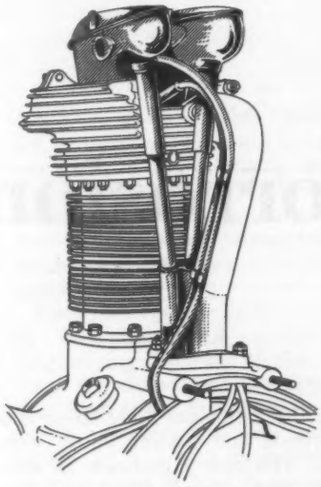


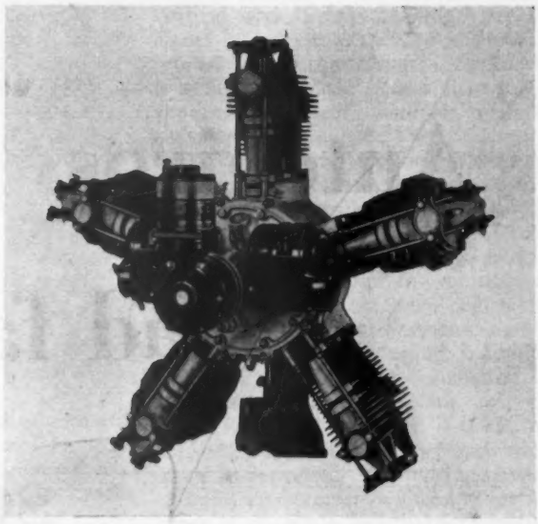
Variety Manufacturing Company's wheel and brake

Spark plug cooler for Wright engines

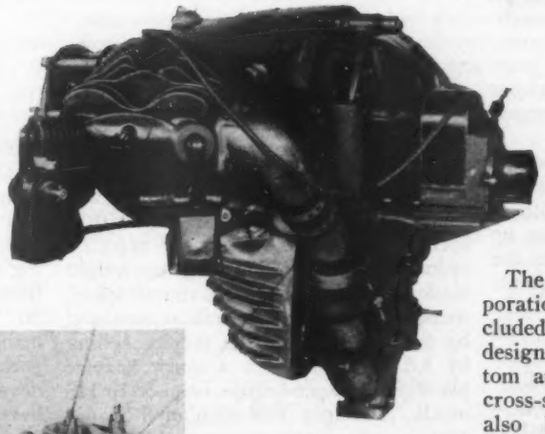


Push rod housings on Kinner engine

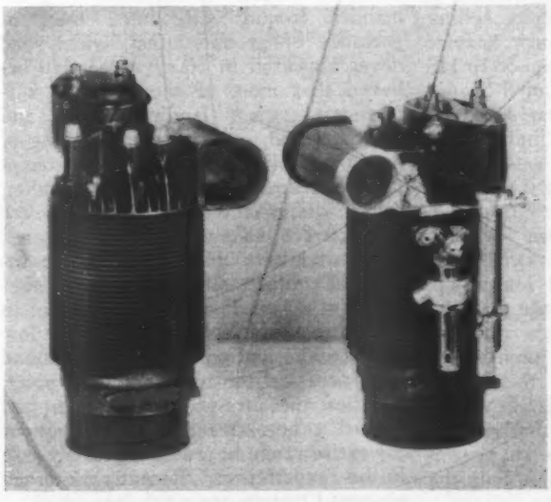




Above: New Szekely five-cylinder radial engine. Left: Aeronca two-cylinder opposed engine



Below: Cylinders for Packard Diesel with new air valve



as is commonly used for interconnecting airports and weather reporting stations, and Western Electric showed radio equipment for airports and transports.

Welded steel wing beams, heat-treated in full length after welding, were exhibited by the Metallurgical Laboratories, Inc.

The Variety Manufacturing Company of Dayton, Ohio, formerly contractor to the Bendix Brake Corporation, have developed and placed on the market a low-pressure type airplane wheel and brake. The striking feature of this equipment is the operation of the brake shoes. The two or three shoes of each brake are expanded outward by the action of a rotating plate cam acting against roller followers mounted on the shoes. The shoes float freely, instead of being hinged at one end in accordance with ordinary practice. There is no servo effect, and there is positive withdrawal of the shoes from contact with the drum when the cam is turned back to its original position. Aircraft wheels and brakes suitable for low pressure balloon tires, tail wheels for low pressure tires, tail wheel steering devices, shock struts for high pressure tires, and a standardized interchangeable stick and wheel airplane control were exhibited by the Automotive Fan & Bearing Company of Jackson, Mich.

Two new features of Irvin parachutes were exhibited, a quick-release harness for use with the standard seat pack, designed especially for naval aviators, and the Irvin airplane chair in combination with an Irvin form fitting back pack. The latter is intended for use in transport types, where the parachute pack forms part of the seat cushions.

The exhibit of the Edo Aircraft Corporation of College Point, N. Y., included several of their floats of latest design incorporating a 30 deg. vee bottom and the new water rudders. The cross-sectional shape of the floats has also been revised to reduce drag. Floats were also shown by the Aircraft Products Corporation, whose exhibit included a combination ski-wheel device having a hydraulically operated mechanism to retract the wheel.

A new form of low pressure landing wheel was shown by the General Tire and Rubber Company. The tire is of the "doughnut" type, parabolic in shape, with the narrowest part at the tread, so that it is of approximate streamline shape in diametral section. It is designed to reduce the need for "pants" or other auxiliary wheel fairing.

Applications of aluminum and magnesium alloy in engine design were featured in the exhibits of the Bohn Aluminum & Brass Corporation. The latest developments in the use of magnesium, particularly in the accessory field were shown by the Dow Chemical Company. Manifold nose cowlings, and metal stampings were featured by the Buhl Stamping Company, and a complete line of fairing units for airplane wheels, in addition to N.A.C.A. cowlings, were shown by the Hill Aircraft Streamliners Company.

While it is impossible in the allotted space to treat all of the accessories in detail, descriptions of all of the new developments will appear in future issues of AVIATION.

Autogiros, load factors, seaplane corrosion

THE Society of Automotive Engineers' aeronautic meeting at Detroit opened with Comdr. E. W. Rounds' paper on commercial flight testing, a plea for more reliable performance data and closer standardization of procedure in securing them.

Commander Rounds summarized the standard methods of performance testing and the precautions to be taken both in making the flights and in working up the data. He laid special stress on the necessity of calibrating all instruments and taking nothing for granted. Even tachometers, strut thermometers, and stop-watches he considered as suspect until proven. The paper also called attention to the necessity of making a careful study of the general characteristics of the airplane before starting a performance test, and particularly of making sure that the best conditions of engine operation and the best propeller setting had been determined. He offered as a rough general rule that a change of 1 deg. in propeller blade angle would change the full-throttle engine speed by about 60 to 70 r.p.m.

Among the small and easily overlooked, but important, factors mentioned by Commander Rounds for the guidance of the pilot were the desirability of starting a climbing test across wind to eliminate the effect on climb of wind gradient near the ground, the avoidance of all cities, mountainous areas, clouds, and irregular terrain in general during the climb test, and the making of as few as easy turns as possible. Summarizing his conviction of the importance of unified and impartial performance testing on all commercial airplanes, the author suggested that the work could best be done by, or under the immediate supervision of, the Aeronautic Branch of the Department of Commerce [as urged editorially in AVIATION from time to time in the past].

Quite apart from its primary purpose, the paper included some interesting data and comment on the mutual relations of the various performance characteristics and on the way in which they would be affected by certain specific changes in airplane design. For example, it was found that on a light machine, with a speed range of from 57 to 158 m.p.h., a reduction of 9 per cent in gross weight made no change in the maximum speed, increased the rate of climb at sea level by 6.5 per cent and the service ceiling by 8.6 per cent. On a much heavier plane, with a speed range from 58 to 113 m.p.h., a weight reduction of 12.5 per cent increased the maximum speed by 2.2 per cent, the rate of climb at sea level 43.5 per cent, and the ceiling 44.8 per cent. Most of these figures are in good agreement with the results drawn from recognized performance formulas such as were analyzed in AVIATION for January, 1931 (p. 55) and March (p. 187), and with the general rule that airplanes having a speed-range ratio of from 2.5 to 3.5 show a maximum speed virtually independent of the gross weight of the plane. It is, however, difficult to see from the fundamental theory how the percentage change in rate of climb could ever be less than the percentage change in weight.

Landing Speeds

Several of the engineers present were anxious for the chance to question Commander Rounds about landing speeds. Theodore P. Wright, chief engineer of the Curtiss Company and chairman of the meeting, sought more light on the method of determination. The speaker recommended a trailing-bomb air-speed meter, but believed that very good results, usually within a mile an hour of the truth, could be obtained with an ordinary pitot tube mounted on a strut. Edward P. Warner, editor of AVIATION, expressed surprise at the author's declaration that minimum flight speed at a small altitude and landing speed were identical. His own experience, he said, had been that ground effect and loss of speed in the final instant before landing accounted for a difference of from three to five miles an hour, or even more on low-winged monoplanes. Commander Rounds discounted the importance of ground effect, which had never appeared in Navy tests. He believed that most of the apparent difference between landing speed and stalling speed was due to the making of heavy pancake landings in the attempt to show an abnormally low landing speed, whereas the Navy test pilots were instructed to make normal landings on a path tangent to the ground at the instant of contact. Mr. Warner also suggested the need of extreme care in calibrating air speed meters at low speed. The author of the paper found little occasion for worry on this point, also, as the air-speed calibration had proved to be a straight line throughout the entire range in practically every case in his experience. Recently designed air-speed meters are much less sensitive to angle of yaw than those previously used, and their readings at a normal flight attitude are therefore less dependent on calibration.

Several questions were asked about the possibility of establishing quantitative specifications for stability and control. Commander Rounds offered only some general rules, which he believed quite satisfactory for longitudinal stability and less so for motions about the other axes. He was pessimistic about any complete elimination of the personal equation. Mr. Richard Mock of the Fokker Aircraft Corporation and Mr. Warner both urged a wider use of the photographic method of measuring

Detroit deals with and sundry other subjects

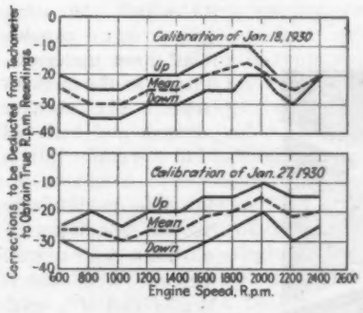
minimum speed, and Mr. Mock pointed out that the use of photography for that purpose was now virtually standard in Europe, especially at the official German laboratory. Commander Rounds thought the introduction of photography hardly necessary, as the present method is very satisfactory.

Capt. George B. Patterson, formerly of the flight test section at the Engineering Division of the Air Corps cited the desirability, in opposition to the views of the author of the paper, of making speed course runs with a cross wind. In that way variations of wind velocity came in only as a cosine factor and had relatively little effect on the apparent speed of the machine, whereas with the wind along the course in accordance with the usual present-day technique any wind variation during the run introduces direct error in speed equal to half the change of wind velocity.

Testing airplane fabrics

Charles J. Cleary, long in charge of the development of textile materials for the material division of the Air Corps, discussed the use of fabrics in aeronautics. Mr. Cleary devoted most attention to the methods of testing fabrics, including the making of such highly specialized measurements as those of porosity of parachute fabrics, and to the effects which the conditions of test have upon the apparent properties of the material. A sample of airplane cloth, for example, had its measured tensile strength increased from 77 to 91 lb. per inch of width when the speed with which the fabric was stretched in the course of testing was raised from 1 inch per minute to 20 inches per minute. The same fabric would sustain a load of 80 lb. per inch, gently applied, without immediate rupture, yet a load of 60 lb. was sufficient to cause breakage at the end of 5 hours, and 40 lb., or half the normal strength, would cause failure after 10 days of steady application. The behavior of fabrics in this respect, is quite different from that of metals and other inorganic and truly elastic materials.

The discussion of Mr. Cleary's paper was brief. The chairman of the session, T. P. Wright, wanted to know how long fabrics should last on an airplane. Mr. Cleary declined to give any definite figures. The fabric, he said, would be good as long as the dope was. When the dope began to show cracks especially the characteristic spiral cracking, it meant that the fabric underneath had been affected, and was ripe for replacement. In answer to another question on the tautness with which fabrics should be applied, he gave assurance that there was no danger of overstretching the material in manual application. A workman could not stretch it tightly enough to do it any harm. There was some little discussion of the rapid failure of fabric, and especially of the slackening of doped fabric surfaces, in the tropics, with the answer provided by Mr. Robinson of the Sherwin-Williams Company, who reported that British experience had been that a special dope of unusually pronounced tautening qualities should be used in tropical areas, and that it should be actually applied in the region where the airplane was to be flown.



Calibration curves for a typical standard tachometer

Autogiro rotor vibrations

The problems of autogiro design were explained, with more emphasis upon practical layout and structural planning than in any paper previously given on the subject, by W. Lawrence LePage, chief engineer of the Kellett Aircraft Corporation. Mr. LePage laid special stress upon the necessity for careful balancing of the rotor blades and for a nice adjustment of the location of the vertical and horizontal hinges in the blades in order that they might stabilize properly. The mounting of the blades is a far less simple matter than might appear at first sight. Senor de la Cierva considers, for example, that it is necessary to give special attention to the relation between the natural frequency of a rotor blade considered as a simple pendulum and the normal rate of rotation of the rotor. If the two frequencies are in a simple ratio of an even number, so that the distance between blades corresponds to a natural harmonic oscillation of the freely-swinging individual blade, the problem of oscillation of the rotor blade in plane of the rotor is much simplified. It is not absolutely essential that any such oscillation be permitted. It would be possible to build an autogiro without a vertical hinge in the blade, and that was done in the early machines, but the hinge is very desirable to relieve stresses in the blades. To prevent unduly violent oscillations of the blades in their own plane, there is a shock-absorbing and damping device in each of the wires which runs from blade to blade.

Another problem emphasized by Mr. LePage was that of the adjustment of the lift of the fixed wing so that the rotor speed may remain constant. If the angle of incidence of the wing were too large, its lift at high speeds would be so great as to relieve the rotor of load, and the rotor would slow down, possibly to a dangerous degree. By proper proportioning and mounting of the fixed elements, the rotor r.p.m. can be kept constant.

Stability and control

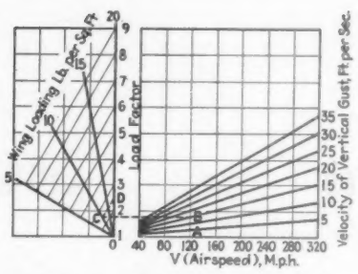
The problems of stability and control of the autogiro are highly specialized. It has been found that the fixed wing center of pressure should be just under the axis of rotation, and that the center of gravity of the machine should be from one to two inches ahead of the axis. It is difficult to avoid either extreme sensitivenesss of control at high speeds or inadequate range at low speed, and it may prove advisable to use a variable-gear-ratio control, such as was employed on the Curtiss Pulitzer Race machines from 1922 on. The practice at present recommended by Mr. LePage is to use a very small stabilizer and large elevator, with a bungee cord on the stick to take the place of stabilizer adjustment. The speaker said that the aileron and fixed wing of the autogiro never reached a stalling attitude, being saved from it by the downwash of the rotor, a claim which occasioned a considerable controversy during the discussion. Mr. Clayton of the Pitcairn Autogiro Company suggested that the aileron control during vertical descent owed something to the forward position of the center of gravity, which made the ship settle vertically with the nose slightly down, and therefore gave some horizontal velocity over the wing even

when the flight path was exactly perpendicular to the earth.

Mr. LePage also called attention to special difficulties in the landing gear design for autogiros. The difficulty was not with high loads, as they had proven to be smaller than was expected, and in fact the landing gear load factors could be lower than were conventional in airplane design. In response to a question about the possibilities of a freely castored landing gear like that used on certain early airplanes, permitting the machine to land forward, backward, or sidewise with equal freedom, Mr. LePage had no objection to offer, but thought that such extreme methods would hardly prove necessary.

A much-interested audience put a number of questions on points of detail. Responding to their inquiries, Mr. LePage said that the flattest glide of an autogiro was a little steeper than that for an airplane but not much, that the speed of descent was proportional to the unit loading of the disc area of the rotor, and that the inertia of the rotor would probably be a safeguard in apparent inverted flight due to sudden atmospheric disturbances, but that he saw no reason why an autogiro should ever be put in the inverted position, and hoped that it never would.

Mr. Wright wanted to now why four blades were used in preference to any other number. The answer was that

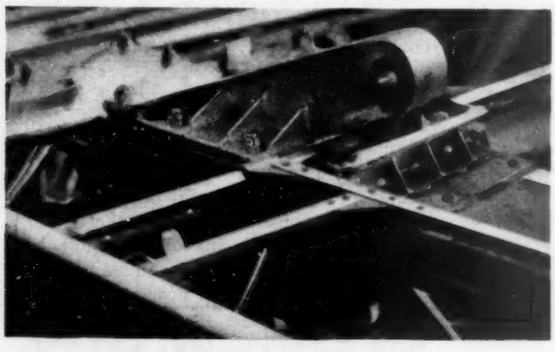


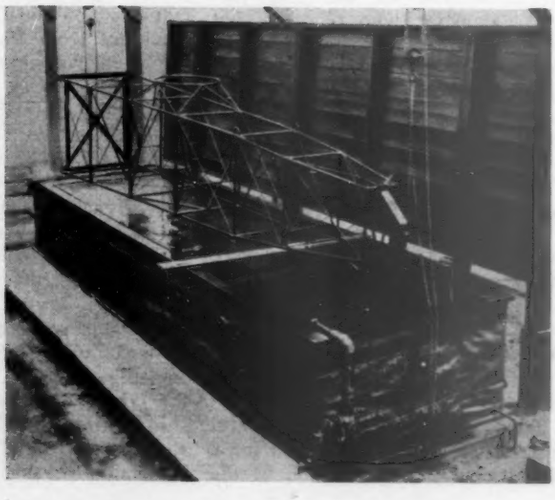
When the plane flies 120 m.p.h., and carries 10 lb. per sq.ft., and meets a 15 ft. per sec. verticle gust, the load factor is 2.5 (read from A to B to C to D)

Senor de la Cierva had experimented on all numbers from two to five, and had found four to be the best practical compromise. The speaker, however, believed that a three-bladed rotor might prove better for smoothness of operation.

In response to questions about the limits of size of autogiros, Mr. LePage declined to commit himself definitely. He saw no reason for imposing any absolute limit, but in connection with the discussion of super-light autogiros he pointed out that the rotor must not be too lightly built, lest the centrifugal force be too small in comparison with the air load and the coning angle of the rotor become excessive.

Ralph H. Upson of Stout Engineering Laboratories, suggested that the speed of which the autogiro was capable was often underestimated at the present time. The speaker agreed, and believed that very high speeds would be attainable, particularly if the condition of absolute vertical descent were abandoned and if a minimum landing speed of 20 or 30 m.p.h. were permitted.





Above: A steel-to-duralumin assembly, where insulation is necessary. Right: Welded structures can be dipped complete.

Structural loads in bumpy air

The much vexed question of structural loads in bumpy air, become a peculiarly poignant issue at present because of the recent transport crash in Kansas, was treated by Richard V. Rhode of the National Advisory Committee for Aeronautics (Mr. Rhode contributed an article on the application of pressure distribution tests to airplane design to AVIATION for February).

Although the National Advisory Committee has for some time been engaged in making measurements of actual structural loads in rough air, installing accelerometers on transport planes, the work has not progressed far enough to permit Mr. Rhode to give any very detailed results. He confined himself to an exposition of the theory, with some practical evidence for its verification, and to a statement of the magnitude of the atmospheric motions likely to be encountered.

The formula for the load factor on airplanes suddenly encountering a vertical gust is: $N = 1 + \frac{\frac{1}{2}\rho a U V}{b}$, where a is the slope of the lift curve in absolute units and with the angle of attack in radians; U the velocity of the vertical guest in feet per second; V the speed of flight of the airplane, also in feet per second, and b the wing loading in pounds per square foot. As there is relatively little difference in lift curve slope among the commonly used airfoil sections, that factor can be taken as virtually constant and the formula then becomes:

$$N = 1 + \frac{5{,}3}{\frac{W}{S}} \cdot \frac{V}{100} \cdot \frac{U}{10}$$

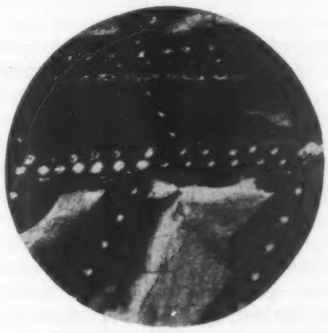
Such formulas are not wholly new (the subject was first investigated along these lines by J. C. Hunsaker and Dr. E. B. Wilson at Massachusetts Institute of Technology in 1914) but they are useless for practical purposes without some definite knowledge of the magnitude and velocity of vertical currents and of the suddenness with which they may be encountered. Mr. Rhode gave data derived from a combination of meteorological experiments, observations on the vertical velocities required for the formation of a hail, and recent measurements of airplanes in flight. He estimated that in line squalls and thunder storms the vertical velocity might range from a common figure of 44 ft. per sec. to a maximum of 110, a 75 m.p.h. vertical wind, and that they might extend up to an altitude of 20,000 ft. "Line squalls and thunderstorms," said Mr. Rhode, "involve conditions so severe that they must be avoided. They are not conditions for the structural designer to consider, but for the weather forecasters associated with air transport operation."

Milder vertical currents are encountered in mountainous country and where irregular heating produces con-

vection currents. The two classes are of the same order of magnitude, which Mr. Rhode estimated as ranging up to 27 ft. per sec. vertically.

To show that the theory nearly corresponds to the facts, several airplanes of varying speed and wing loading were flown in rapid succession through the same bump. Accelerometer records of load factors were taken, and the formula just given was used to work backward to the vertical velocity of the air. The records for the three machines all indicated a vertical velocity of between 10.6 and 11.2 per sec.

A machine with a wing loading of 15 lb. per sq.ft., and a high speed of 185 m.p.h., roughly the characteristics of the fastest of the present-day light transports, would sustain a load factor of



Rivet corrosion at work

3.5, close to the maximum for which transport planes have to be designed, if it encountered a vertical gust of 25 ft. per sec. velocity. Such a velocity would be quite possible along a wind-shift line or among rugged mountains. The structural dangers of bumps are further enhanced by the fact that, as Mr. Rhode pointed out, maximum loads do not commonly correspond to the angle of attack of maximum lift coefficient, for which the wing truss is figured to have its greatest strength. In the case just mentioned the maximum load factor would be encountered at a lift coefficient of a little less than half the maximum, and the loads on the rear wing spar would thus be particularly high.

The problem obviously becomes more acute as aerodynamic design improves and operating speeds tend to increase without increasing wing loading.

In the course of the discussion Ralph H. Upson, original designer of the Navy's metalclad airship, suggested the need of studying "candard" or tailless planes, and planes with yielding structural elements, in order to reduce the effect of vertical currents. Particularly, he thought that it might be possible to work out a tailless plane so that the forward elevator would serve as a sort of an antenna to detect the drift and start a corresponding adjustment of the angle of attack before the wings had reached the disturbed air. Mr. Warner protested that no vertical yielding of the structure could possibly have any very substantial effect, as the amount that could be provided would be trivial compared with the motion of the plane in space. He estimated that a wing would have to move about 25 ft. vertically in relation to the fuselage to reduce the loading on the structure by 25 per cent in a bad bump. Torsional yielding of the wing to modify the angle of attack directly could of course be very effective, but it introduced danger of flutter, especially in high-speed machines.

Corrosion prevention

At the seaplane session there were but two papers, both presented by the chief engineers of companies intimately associated with the construction of large marine aircraft. Lessiter C. Milburn, of the Glenn L. Martin Company, gave an exhaustive treatment of corrosion prevention.

Mr. Milburn classified the means of coping with corrosion under three headings, the use of non-corrosive material, the use of protective coatings, and the execution of design details in such a way, and the use of the material in such form, that corrosion danger will be minimized. In practice, no one of the three alone can suffice.

Mr. Milburn explained the failure of ordinary paints and varnishes as being due to their hygroscopic quality, permitting spots of corrosion to form under the coating even before its continuity had been broken. Forest Products Laboratory tests showed that three coats of spar varnish had a moisture-stopping efficiency of but 60 per cent, while asphalt or bituminous paint with aluminum pigment showed 98 per cent efficiency. The addition of the pigment increases the efficiency slightly, but it was also recommended as necessary to prevent cracking of the coating when exposed to sunlight.

The principal objection to the bituminous paint is its unevenness of appearance and its low resistance to abrasion. Mr. Milburn recommended against the product where handling would be constant, as on seats or cowlings. For particularly difficult exposures, surfaces that have to be periodically immersed in sea water, and so on, he suggested protective coatings based on grease or wax, which should be compounded with aluminum powder. There is an inherent danger in the use of grease in that if it be not chemically neutral it may act as a corroding agent itself, especially when contaminated with salt from the atmosphere or from sea water. The use of mineral oil preheated to about 250 deg. F. for coating inside of tubes was reported as now being a general practice.

Other coatings considered were sodium silicate, most used to suppress porosity in castings rather than to prevent corrosion, and bakelite varnish, now being especially studied for gasoline tank interiors because of its insolubility in gasoline, benzol, ethyl fluid and all the other miscellaneous products that are likely to form a part of a fuel.

The author made favorable report on an experience with Alclad, although seaplane floats plated with that material had been found to show extensive corrosion after a year of service. An additional protection of the surface was recommended, and special stress was laid on the need of a non-hygrosopic paint such as the bitumastic.

The major advantages of the chemical and electro-chemical treatments were simplicity of application, ideal preparation of the surface for the adhesion of paint, and extreme resistance to the penetration of moisture to the underlying metal. The aluminum hydroxide coating produced by the anodic treatment insulates the aluminum alloy from moisture, and prevents the passage of currents from the surface and the starting of electrolytic action.

Quite as important as the proper choice of protective coating is the proper design of the basic parts. Special care should be taken, Mr. Milburn emphasized, to provide for the ventilation and drainage of all points in the structure. Parts of different materials should always be insulated from each other and materials of markedly different electromotive potentials should never be brought close together in a structure. Duralumin is better protected from wood or fabric by laying a thin sheet aluminum foil over the surface than by the use of an anti-dope paint. All members should be painted before assembly, with more paint applied over and around the joints of the finished structure.

Dornier technique

Mr. Milburn's paper led to a lively discussion, in which Lieut. C. H. Schildhauer of the Dornier Company of America, and lately of the piloting personnel of the DoX, and Mr. Nagel of the Aluminum Company of America took the leading part. Lieutenant Schildhauer described Dornier methods of protecting duralumin from corrosion as being simple in the extreme. The principal reliance was placed on a perfectly uniform condition of the heat-treated material, and that was insured by having the heat-treating done at the aluminum mill as fast as possible. The Dornier boats were so designed that the forming operations on the sheet at the airplane factory could in most cases be performed without disturbing the state of the material so as to reqiure annealing and re-treating. In particular, it was general Dornier practice to form profiled sections from sheet by rolling instead of by using a draw-bench. Mr. Nagel heartily endorsed the more general use of factory treating of material, and remarked that it was not generally

appreciated how much work could be done on pre-treated sheet without injury. For example, most of the structural elements of the airship Akron were being formed at the Goodyear factory from sheets heat-treated by the Aluminum Company before delivery, and were receiving no subsequent treatment.

Mr. Nagel continued with some general observations about the causes of corrosion. As he visited aircraft factories, he had found bad practices in the handling of light alloys very frequent, especially in the treatment and driving of rivets. One of the most common faults was the unduly slow cooling of the rivets after heating. They should, of course, be quenched suddenly. He also found frequent neglect of the preparation of the surface before painting, with blistering of the paint as a result. Large blisters were likely to form, for example, on benzol-cleaned surfaces, but never appeared over the anodic coating. Designers either did not know enough about the causes of corrosion and the means of preventing it by proper selection of material and proper proportioning of elements, or did not give enough thought to what they did know.

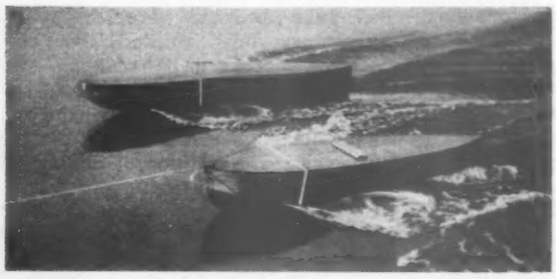
Alclad in service

Remarking on Mr. Milburn's report on his experience with Alclad floats, Mr. Nagel called attention to the fact tht the aluminum coating had nowhere corroded completely through on those floats, that there had been no loss of mechanical properties, and that another Alclad float which had been nineteen months in service on the Magdalena River, with very little protection, had corroded completely through the aluminum skin in some cases but with no injury to the duralumin core at any point.

Mr. Lee of the Keystone Company inquired about the possibility of indefinitely repeated heat-treatment of rivets which had not been used within the permissible time after the first treatment and had therefore had to go back to the furnace. He suspected damage to the material by constant repetition of heating and quenching. Mr. Milburn and Mr. Nagel agreed, however, that there was no evidence to indicate any such damage, and specific tests by the Aluminum Company had shown no change in mechanical properties after 20 cycles of heat treatment.

Mr. Korvin, chief engineer of the Edo Corporation, inquired about the possibility of eliminating the heat-treatment of rivets in field riveting. The answer was that certain minor modifications of the standard 17-ST alloy, known as A17-ST and B17-ST are capable of pretreatment at the time of manufacture and of being driven cold at any time thereafter. As they are an alloy differing in composition from the 17-ST, however, there would be danger of electrolytic action if they were used in conjunction with it. Their use in conjunction with Alclad, with which no such danger arises, is permissible. Recent investigations have shown that the electrolytic protective action of the pure aluminum skin on Alclad, giving protection even to duralumin surfaces where the aluminum coating has been scraped away, to extend farther than had been thought possible. Even when the core of the metal has been scraped bare over a diameter of 1½ in. it has been subject to no corrosive action.

Mr. Den Tex called attention to the common practice in shipping operations of bolting zinc plates against the hull of the ship near the stern in order that the difference of potential between the zinc and the steel hull and the bronze propellers may safeguard the steel and bronze from corrosion and from mutual electrolytic action. They are protected at the expense of the zinc, which is completely corroded away and replaced from time to time. Mr. Nagel hardly thought that such a practice would be useful in aeronautics, as the potential difference between zinc and aluminum alloys would be in the wrong direction. Only magnesium would be useful as a protective material for aluminum, and that would corrode so rapidly in sea water that magnesium plates could hardly be replaced often enough to make the protection continuous. He was not prepared, however, to say that the idea had no possibilities, and Richard Mock of the Fokker Aircraft Corporation said that he had heard reports from Russia that zinc plates were being used on aircraft exactly as on ships, either being left continuously in place or attached to the light alloy elements by wires after each flight.



Sikorsky models running abreast for wave comparisons

Open water model testing

At the same session Igor Sikorsky described a means of escape from the dilemma occasioned to the flying boat designer by the scarcity of model tests basins in the United States. Pending the completion of the new tank at Langley Field, practically all of the model testing has had to be done at the Washington Navy Yard, where the physical facilities are very limited and only a small part of the total capacity of the tank can be devoted to seaplane hull work. Mr. Sikorsky therefore undertook to replace the towing basin by towing models in open water, with very satisfactory results. The model was towed by a string attached to the bow and connected to a long out-rigger from a speed boat. Models of flying boat and amphibion hulls, of from one-fifth to one-tenth full size have been used and the studies have included both measurements of resistance of many different hull forms in smooth water and the analysis of wave formation and of steadiness of motion in a seaway. The towing is of course done at from a half to a third of the speed of the full-sized machine, corresponding speeds varying as the square root of the linear dimensions in accordance with the well-known laws of similitude for wave-making resistance. Moving pictures which accompanied the paper showed the model hulls to tow with astonishing smoothness, even when there was a distinct ripple on the surface.

Among the participants in the discussion which followed were E. D. Osborn of the Edo Aircraft Corporation, B. V. Korvin, chief engineer of the same company, and E. P. Warner, chairman of the session. In response to various questions about the accuracy of the method, Mr. Sikorsky agreed that it was an aproximation and that it required periodic checking by tests in a model basin, but assured his audience that it had been found very satisfactory for qualitative comparisons of probable performance before and after small modifications of design. He emphasized the impossibility of considering an amphibion in exactly the same category with a flying boat. The hull could not be designed from the point of view of hull efficiency alone, but had to take account also of the convenience of mounting of the wheel gear, of the location of the tail-wheel or skid, and of the necessity of protecting the landing gear from the impoct of solid masses of water. The wave formations and cast of spray observed on the models had checked very nicely with those from full-sized hulls from the same design, and the models ordinarily ran steadily enough so that longitudinal stability was not a serious consideration. In particular, it had been found unnecessary to distribute the weights on the model so that its moment of inertia should be in strict proportionality with that of the full-sized machine, although of course the center of gravity had to be kept in an exactly corresponding location.

Light engine design and fuels discussed by the S. A. E.

Insley, Nutt, Bridgeman, Edgar and others talk of power plant problems

ROBERT INSLEY, of the Continental Aircraft Engine Company, opened the talk which he gave to the Society of Automotive Engineers in Detroit on the subject of low-powered light engines by apologizing for not having completed his manuscript in time for the distribution of reprints. He had feared, he explained, that if he attempted anything of that sort the material that the paper contained would all go out of date while the presses were running, and indeed he was somewhat alarmed lest what he had to offer should already be antiquated, as it was at that time nearly 24 hours old.

As might have been foreseen from that introduction, Mr. Insley lamented in detail the difficulty of forecasting light power plant demand. When his company undertook to design an engine for light service, they had found it equally impossible to make any reasonable estimate of the quantity likely to be required and to secure any homogeneity of opinion among the airplane designers on the kind and size of engine that they wanted. They had had to depend on their own observations, and those suggested that the "light" airplane was again following the normal cycle that it had followed on each of its previous incarnations in the industry, a cycle of steady increase of power and of steady evolution away from the ultra-light class. Thus, the light planes that appeared at the National Air Races in 1924 had, some of them, grown up to training machines with from 60 to 100 hp. Thus the DH53 of 1923, powered with a twin-cylinder motorcycle engine, had been the lineal ancestor of the DH Moth. Thus it appeared again that the demand was constantly for greater power, and little was being heard now of the 20-hp. engine popular in the first stage of the present movement.

Trying to estimate the point of stabilization, Mr. Insley came to the conclusion that there was going to be a reasonably general requirement for two distinct classes of engines. The first would be of about 35 hp. and would be extremely cheap in construction, intended to be installed in light training machines and in planes to be sold to private purchasers for whom economy was the predominant, if not the sole, consideration for selection. The second class would include power plants of about 50 hp., somewhat more expensively constructed and fitted with more accessories. The smaller of the two engines would have nothing but a tachometer drive. The larger would include provision for starter, generator, and perhaps some other auxiliaries.

How many cylinders?

The speaker concluded that any number of cylinders larger than four had to be eliminated on grounds of production costs, and that a four-cylinder vertical air-cooled was also too expensive a type. The horizontal opposed twin-cylinder form is cheapest to build, but, to quote Mr. Insley, "when one plug is fouled the remaining cylinder becomes a doubtful asset." Furthermore, he thought the vibration characteristics too bad to be acceptable.

The choice then lies between the four-cylinder opposed and the three-cylinder radial. Mr. Insley found little to choose between them in production cost. Analysis had led him personally to the adoption of the four-cylinder horizontal-opposed type.

He remarked on the suggestion frequently made that gear reduction might be secured in a horizontal opposed engine by driving the propeller off the camshaft instead of the crankshaft, stiffening up the shaft and the timing gears to take the added load, as was done in the air-cooled Renault, nearly 20 years ago. There was no insuperable objection to such an arrangement, which would be very helpful to propeller efficiency because of the low speed of flight and the unfavorable conditions under which the propeller must work on most of the light planes, but there would be obvious drawbacks. Cooling would become more difficult because of the reduction in slipstream velocity, and also because the enlarged diameter of the propeller would move the effective portion of the blades out beyond the cylinders. There would be somewhat more vibration with the drive taken through the timing gears, the engine would be more costly and heavier, and allowance would have to be made for a larger propeller. Nevertheless, it seemed to Mr. Insley that the device might be justified on the larger of the two classifications of light engines.

Mr. Insley had dismissed the two-stroke cycle engine somewhat lightly in his talk. John H. Geisse of the Comet Engine Company came to its rescue during the discussion, protesting that there were two-stroke engines that started more easily than the four-stroke and idled quite as well. They were simpler and cheaper to build, and although the fuel consumption is higher, that ordinarily matters little on private planes, where the cost of the fuel played an almost negligible part in the economic calculations of the average owner.

Prestone cooling

Immediately succeeding Mr. Insley's paper came one covering the other end of the scale. From the lowest powers and air-cooling the meeting passed to the highest powers and prestone-cooling, as expounded by Arthur Nutt, engineering vice-president of the Wright Aeronautical Corporation. Mr. Nutt followed the same general line expounded before the S.A.E. by G. W. Frank of Wright Field at the Cleveland meeting a year and a half ago. [AVIATION, Aug. 31, 1929], but he has carried the studies farther in application to a specific engine, the Curtiss Conqueror.

In surveying generally the position of high temperature liquid-cooling, Mr. Nutt pointed out that the engine design has to be reconsidered to meet new conditions. The strength of some of the aluminum alloy parts is likely to be seriously lowered by the increased operating temperature. The difficulty of cooling pistons is increased, and oil cooling demands more careful consideration than when water-cooling is used. The high temperature coolants are much more likely to leak than is water, and special precautions have to be used to make the cooling system tight, to use high temperature solders, and generally to avoid material which would deteriorate at 300 deg. F., especially in gaskets and hose.

The measurements on power output show results in good general accord with those of previous tests. It is universal experience that power falls off with increasing cooling temperature, especially when liquid-heated inlet manifolds are used, mainly because of lowered volumetric efficiency. In the case of the Conqueror engine tested by Mr. Nutt, raising the outlet temperature of the coolant from 180 deg. F., to 300 deg. lowered the power approximately 5 per cent for all compression ratios.

Fuel consumption

Studies on fuel economy did not yield such good agreement with past experience. Mr. Frank's curves had shown approximate uniformity of fuel consumption for all coolant temperatures. The curves presented with Mr. Nutt's paper, on the other hand, show a decided improvement in consumption at a temperature of 240 deg., as compared with either higher or lower figures. The economy records for 180 deg. and 300 deg. were almost identical. At 240 deg. consumption at full power was 5 per cent lower than either of the extreme temperatures. Throttled to conditions representing cruising speed in an airplane, the differences were less marked, but they were still in the same direction.

Mr. Nutt summarized the case in his closing paragraphs:

"In power units above 600 hp. it appears possible to develop power units which will weight about one and one-half (1.5) pounds per horsepower including radiator, piping and cooling liquid which is comparable to the large air-cooled units. . . . Liquid-cooled engines of large powers have a definite field in large patrol boats, transport airplanes, various military airplanes and dirigibles. Cost no doubt will prohibit the use of the lower powers in liquid-cooled engines as the air-cooled engine covers this field very satisfactorily. However, the demand in commercial service for quieter and smoother engines may turn some designers toward the use of the high speed geared engines of small bore for certain types of aircraft."

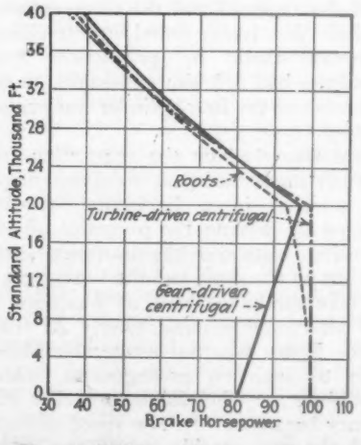
Radiator location

The rest of the paper included some interesting observations on radiator design, not necessarily limited in their application to prestone-cooled power plants. The author recommended that both radiators and oil-coolers should be placed as far aft as possible, keeping the nose of the airplane as clean and free from disturbance as possible. There is ample aerodynamic laboratory information to support that injunction, but it is often overlooked by designers. Having picked a location for the radiator, Mr. Nutt proposed that it be streamlined so that it would offer a minimum of air resistance, the air flowing into the fuselage, through the radiator, and out again, instead of leaving the radiator freely exposed and creating as much disturbance as possible. Specifically, he assured his audience that the radiator could be stowed away inside the bottom of the fuselage so that the opening to admit the air could be at least 30 per cent smaller than the frontal area of the radiator itself. In using prestone or other high-temperature coolants, the problem of radiator shutters solved itself. Mr. Nutt recommended strongly against their installation in any such case, as he had no fear of over-cooling of the engine and preferred to have it run in all cases at as low a temperature as possible.

Supercharger performance

Oscar W. Schey of the National Advisory Committee for Aeronautics analyzed supercharger performance from a joint background of theoretical study and flight tests. Although most of the pioneer work of the National Advisory Committee has been done with Roots blower superchargers, Mr. Schey did full justice to the centrifugal forms.

On the assumption that an intercooler is employed, so that the air reaches the carbureter at the same temperature at all altitudes, curves of maximum performance were constructed for various types of supercharger. These

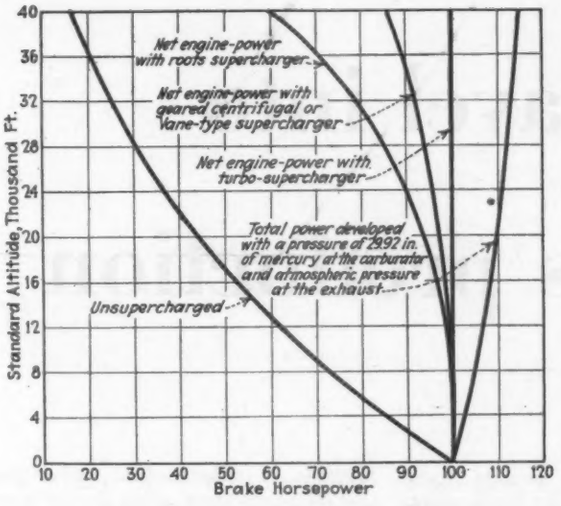


Power-altitude curves. (Superchargers designed for critical altitude of 20,000 ft.)

showed that up to 20,000 ft. altitude there is but little difference among the three forms, the turbo supercharger holding the full sea level power while the power with a Roots blower dropped off about 7 per cent. Above that altitude, however, the curves begin to spread out rapidly. Mr. Schey found particular fault with the methods of control on the direct-driven superchargers, and especially with the throttling control used on the geared centrifugal form. Other curves showed the net power developed by superchargers of the three types, each designed for a critical altitude of 20,000 ft. and each being operated to hold the intake air pressure constant up to that altitude. Relative inefficiency of the throttling control on the geared centrifugal supercharger is shown in a loss of 20 per cent of the power at sea level. Dr. S. A. Moss of the General Electric Company, made the point during discussion, that this hardly represented the actual conditions, as in practice the pilot would allow the intake pressure to rise a little above atmospheric so that the power developed would remain substantially at the rated figure all the way up.

Flight tests confirmed the theory in showing the turbo-centrifugal type to give the best results. There was relatively little difference in climbing characteristics, but the maximum speed attained rose from 112 m.p.h. at sea level to 122 m.p.h. with a Roots blower and 134 m.p.h. with the turbo supercharger at 12,000 ft., as against a speed of 95 m.p.h. at that altitude when unsupercharged. At 24,000 ft. the Roots blower showed 119 m.p.h., the turbo supercharger 142 m.p.h.

Mr. Schey closed his paper with a discussion of the effect of "boosting" by supercharging to above atmospheric pressure at sea level. He found that with a low compression ratio the maximum exhaust gas temperature rose rapidly with supercharging, and for that reason among others he recommended definitely against the use of sea level supercharging with any compression ratio less than 4.5:1. The power output went up in approximate proportion to the intake pressure for all compression ratios, while the fuel consumption remained virtually the same as for the unsupercharged engine. The maximum cylinder-pressure was affected much less by supercharging than by increased compression ratio. Thus it was possible to get the same brake mean effective pressure with a compression ratio of 7.5 and no supercharger, with 6.5 and the intake pressure raised by 1¼ in. of mercury, or with a ratio of 4.5 and a 6-in. rise in intake pressure. The three cases showed maximum cylinder-pressures of 740, 680, and 530 lb. per sq.in., respectively. The fuel consumptions in the three cases were 0.48, 0.51, and 0.62 lb. per hp. hr. The exhaust gas temperatures came to 1,330, 1,350, and 1,460 deg. F.



Power-altitude curves for engines with various superchargers.

In addition to the remarks already quoted, Dr. Moss called attention to the usefulness of a supercharger in giving a reserve of power at low altitudes which could be called on briefly in emergencies by opening the throttle wide and running the engine far beyond its rated output. He considered it quite practicable to attain brake mean effective pressures of 200 lb. per sq.in. by sea-level boosting.

Arthur Nutt criticized the turbo supercharger because of installation difficulties, and also, especially for military service, because of its poor acceleration, which made it difficult to hold planes to their proper place in formation. He thought the mechanical difficulties worse for the Roots blower than for the geared centrifugal type. Mr. Geisse pleaded the cause of high compression ratios as against supercharging, arguing out that the supercharger required both more radiating surface and better fuel than were needed without it, and that the same changes would permit of raising the compression ratio. Mr. Schey replied that a 50 per cent power increase by supercharging required only 34 per cent increase in radiation surface. As for increasing mean effective pressure by increasing compression ratio, the length to which that could be carried without undue rise in engine weight is limited by the rising values of maximum explosion pressure. Dr. H. C. Dickinson of the Bureau of Standards questioned Mr. Schey's last statement, observing that the maximum explosion pressure increased only very slowly with increasing compression ratio after the compression ratio reached the value of about 7.

Detonation and fuel testing

Dr. Graham Edgar, the director of research of the Ethyl Gasoline Corporation, came armed with evidence of the final success of the students of detonation in arriving at a method of specification for that quality. A series of fuels had been tested in half a dozen laboratories by the method now specified by the Air Corps, using a standardized engine, evaluating quantity of detonation with a bouncing pin indicator, and giving the results either in terms of the octane number of the fuel or of the amount of tetra-ethyl lead that must be added to bring the fuel up to a given high octane number.

On the straight-run fuels and benzol blends that were tested, the extreme spread of the results from the various laboratories amounted to about two units of octane number, with a mean deviation from the average value of about one-half a unit. With a cracked mid-continent fuel, the results were for some reason much more irregular than with the straight-run gasolines or blends.

The curve of tetra-ethyl lead content against octane number was determined for all the fuels by the Ethyl Corporation. In accordance with the general indications of past experience they were reasonably near to being parallel, the lead compound having much the same effect in all instances. Specifically, the addition of 1 c.c. of lead per gallon gives an average increase of 8 in octane number, while doubling the amount increases the octane number by only four additional units.

Vapor lock at high altitude

Factors affecting vapor lock were discussed by Dr. O. C. Bridgeman of the Bureau of Standards, whose previous work in the same field had just brought him the Manly Memorial Medal for the best aircraft power plant paper presented before the S.A.E. in 1930. In his contribution to the Detroit meeting in collaboration with C. A. Ross and H. S. White, he dealt specifically with the possibility that vapor lock at high altitudes might be caused even in a fuel system quite immune from difficulty near sea level, by slow cooling of the fuel after a rapid climb.

By way of fundamental data Dr. Bridgeman explained that the temperature which vapor lock may appear in gasoline decreases about 2 deg. F. for every 1,000 increase in altitude, while the normal drop in atmospheric temperature for every thousand feet is of course approximately 3.6 deg. Temperatures in the fuel system cannot be relied on, however, to remain identical with that of the air around the plane.

Tests completely justified the suspicions that had been entertained, and showed also a remarkable difference between the fuel systems in the rate at which cooling of the fuel takes place while climbing. Thus, when a Navy observation plane was climbed to 1,500 ft. in 29 min., the air temperature had dropped 70 deg., but the temperature of the fuel tank went down only 25 deg. In this case the actual fuel temperature was falling off less than 2 deg. per 1,000 ft., and the vapor lock danger was therefore increasing with increasing altitude. A multi-engined transport, a light bomber, and a training plane gave results generally similar to those for the observation type already mentioned. In a pursuit plane the fuel temperature followed that of the air much more closely, presumably because of the higher speed and the greater degree of exposure of the tank.

In summary it appears that vapor lock at high altitude is a real menace with many present-day fuels and in many airplanes, and must be taken into account both in specifying fuel and in designing the fuel system.

Bearing pressures allowable

Returning from engine fuels to engine dynamics, a paper on bearing load analysis and permissible loads as affected by lubrication was given by F. L. Prescott and R. B. Poole of Wright Field. Their contribution was too formidable to permit of abstracting, including some 20 pages of tables and more than 20 pages of detailed graphical analyses of bearing loads on several engines.

The authors pointed out that the product of pressure and velocity, taken as a measure of the severity of conditions under which the bearing works, is already more than 50 times as high in some aircraft engines as is considered permissible in automobile practice. Under momentary overload conditions, such as those of a power dive, the product may be multiplied by three or four again. Thus, in the Wasp engine, with steel-backed bronze bearing, the normal mean bearing pressure on the crank pin is 1,488 lb. sq.in. and *pv* equals 35,800 lb.ft. per sec. In a power dive, with the engine turning up to 3,500 r.p.m., the pressure rises to 5,160 and the *pv* product to 207,000. A similar overload dive with a Curtiss D-12 liquid-cooled engine, with babbitt-lined bearings, showed a product of 98,500. Tests at Wright Field on a Liberty crank pin with a babbitt-lined bearing showed a maximum *pv* of something under 30,000 for steady operation without cracking of the lining.

Another general rule drawn by the authors from experience was that the ratio of length to diameter of a bearing should not be less than about 0.37. Beyond that figure the engine is prone to flood with oil and the oil consumption to be very high.

Putting air travel into mass production

ONE of the few definite statements that can be made about air transport is that the accepted methods of soliciting and handling passengers differ widely and change rapidly. So far as I can observe, operators are not at all in agreement as to what they are selling or how the selling should be done. Some believe that a luxury service must be maintained to lure passengers into airplanes; some that air fares should be low to get volume revenue; some that they must be comparatively high—at least rail plus pullman standards. There is continuous controversy over the advantages and disadvantages of long and short hauls, as to which serves best (and incidentally pays best). The belief that infrequent schedules are sufficient to carry all who will fly for some time is a school of thought expressed by "When the planes are filled every day it will be time enough for additional service." There isn't even unanimity of opinion whether or not control of routes and rates by the Interstate Commerce Commission would be a blessing or a curse.

Just as widely as fundamentals differ, so do means of carrying them out. Methods of ticket selling, advertising and soliciting show great diversity, and details considered essential by one company look unimportant to another.

So far as the Ludington Line is concerned, the simplest way of working out basic ideas has been the method striven for. It might be interesting to consider what ideas are, as I have been asked to discuss the methods. In doing so I must bring in a little personal history, for the operating plans and procedure are mostly the expression of two individuals' thoughts and experiences.

A bit of history

Gene Vidal and Paul Collins, now executive vice-president and vice-president in charge of operations, became associated in Transcontinental Air Transport. They formed the habit then of looking at maps after hours and establishing mythical airlines between selected points. Almost two years ago the frequent-service idea was contemplated, and ways and means of putting it into force begun. Probably few others than the Ludington brothers of Philadelphia would have backed what was so

The round-trip ticket contains no complicated yardage. Below: Passengers boarding a Ludington Stinson at Washington

By

Amelia Earhart

Vice-President, Ludington Lines

radical a plan. As early as the spring of 1930 they dared to plan the financing of an airline over a route as well served by other means of transportation as any in the world.

The New York, Philadelphia and Washington Airway began operations on Sept. 1, 1930, with six ten-passenger Stinson planes. After six months, 25,863 passengers have been carried, 3,266 trips made, and 669,523 miles flown. Such sizeable totals put the officers of the line definitely on the side of those who believe that real service, as expressed in convenient schedules, is the backbone of air travel—as it is of other forms. The passenger traffic problem then boils down to the best methods of broadcasting one's wares and to giving as much satisfaction as possible before and after the individual passenger takes a trip.

I'll start with the second item and try to tell some of the aims under "before taking." Roughly, they include ease in making reservations, easily accessible knowledge of where this can be done, accuracy in the final sale, certainty of arrivals and departures of planes, quick refunds when weather causes cancellation, low fares, combined with as much comfort as can be indulged in without pampering.

Taking those requisites in the order they are met with by the passenger, it is evident that the Ludington Line has a distinct advantage in having so close an association with the Pennsylvania Railroad. The fact that at all stations along its route tickets are sold and reservations made for air travel, as easily as for rail, counts for much. The service to which the public has become accustomed is at last made available to air travellers, and gives, besides the ease of purchase, a confidence in the new type of travel perhaps not obtained in any other way.

In making airline reservations as routine and positive as those for surface travel, a teletype system connects all Ludington offices and airports. A record of seats sold and to be sold is instantly available from seven in the morning until nine at night. Besides, railroad agencies, travel bureaus, Western Union offices and hotel porters are all used to making reservations. Not only is an efficient system necessary to impress passengers, but it is very important in getting over to agents also the idea that aviation is transportation and pushing ticket sales a bit may be profitable.

Operating without a mail contract and with a frequency of schedule unprecedented over any distance of more than a few miles, and persistently setting world's records for volume of passenger business, the Ludington Line has fixed upon itself the attention of the air transport world. "Every-Hour-On-The-Hour" has become a slogan of universally understood meaning. When traffic ceases to be spasmodic and becomes a regular flow of 150 passengers a day, solicitation is a very interesting problem. Herewith, a few observations on how it should be solved.

Too many ticket channels

To offer airline tickets over too widespread an area, or through too many channels, has definite dangers. There may be trouble through mistakes made by occasional venders, and resulting dissatisfaction. Because of expense it is impossible to keep actual tickets so distributed, and exchange orders must be used. Sometimes the buying public does not like the extra handling involved under these circumstances, and would prefer going a longer distance to get possession of the actual ticket. If tickets are placed in unusual locations, as some enterprising companies have suggested for publicity purposes, not only are mistakes likely but the public goes on thinking aviation is still a circus.

Coupled with the ease in procuring tickets should go corresponding convenience in issuing. Complicated yardage may be important from some accounting and bookkeeping angles, but it could not be used by Ludington. Owing to the tight schedules maintained, no one has time to fill in many details, even if they were considered important. The present ticket more nearly resembles a football pasteboard, and is simple for agents, passengers, and dispatchers, to handle. Passengers are known only as Thompson, 01456, or Jones, 05421, until they sign before leaving.

All the work of the traffic department goes for naught if "Operations" doesn't provide the service described on the time tables. Everything about the planes fall to their ministration. Not only must the mechanical end be maintained but also details of cabin cleanliness, heating and ventilation, placing of signs,

stowing of baggage, etc. I believe nothing gives more confidence to a first rider than a neat interior with clean windows, brushed carpets, and literature and signs as well placed as possible. Unlike any others, Ludington planes carry paid advertisements in the form of modified "car cards" to attract the eye. In addition, of course, are the necessary directional signs, chief of which are "no smoking" notices and those bearing information that air sickness containers are found under each seat. In a two hour journey the smoking question is not very serious. Without a retiring room it is wiser not to jeopardize ten passengers' equanimity by permitting cigars or cigarettes in the cabin. Too often have I seen one whiff of tobacco smoke sink a victim who was struggling on the brink of air sickness to favor abandoning this rule.

Less than 5 per cent ill

Contrary to what some persons think, air sickness signs decrease the malady rather than increase it by suggestion. Most of the suffering is caused by nervousness and nothing augments that more than the fear of being sick and not knowing what do to. Therefore, the line has small metal plates 2 in. square, on the sill of the window at each seat. They read simply, "No smoking. Air sickness containers are located under each seat."

It is interesting to note that the subject of air sickness is one of the first spoken of by prospective passengers. The average of those affected is less than 5 per cent, though of course this differs under different weather conditions. Women are the greater sufferers, but I believe they are braver than men about minimizing circumstances afterward.

One of the best preventives is fresh air, and again NYPWAC is unusually fortunate in having a special ventilating system. Luther Harris, chief of maintenance, has worked out a device which supplies a strong current of fresh air continually to the cabin. The air is heated in winter and is at the temperature of the outside atmosphere in summer. Unlike some heaters, it can never introduce exhaust fumes into the interior of the plane. Probably no single mechanical measure has meant more to the traffic department than the heated airplanes throughout the winter period.

Not only must airplanes fly, but they must do so on time. Air travellers are becoming very particular about tardy take-offs and arrivals, and consider a delay of even ten minutes pretty poor. Such watchfulness may not be so marked on long trips, but certainly is on this short one.

Attendants unnecessary

The trip from Newark Airport to Washington terminal is approximately two hours, and in this time the sole company representative in the plane is the pilot. He can do as much as anyone in the organization to make, or keep, converts to air travel. Handling the plane for the passengers' comfort, landing so as not to disturb timid souls, and a thousand other little details of his thoughtfulness make the difference between repeat business and "never-ride-agains." The cabin of the Stinsons used by NYPWAC permits the pilot to be practically with the passengers. Thus, his every move can be seen and assurance is felt that everything is all right. Further, though he will not carry on long conversation, he can be spoken to. Thus, if the cabin heating is unsatisfactory, or some similar "crisis" arises, anyone can get satisfaction by a quiet request. On long journeys it is probably necessary to have an attendant in the cabin. For so short a trip, an attendant would be in the way.

There are some things which may fall either under "procedure before" or "after" a trip. One of those is methods of refunding for weather cancellations. If at any time a plane is cancelled for any reason, immediate refund it made. Passengers at New York, for instance, are advised in time to receive their money and make a train at the same hour they would have left on the airplane bus, as both leave from the same terminal. There is none of the disappointment of traveling to an airport only to be told the plane will not fly. Similarly, when a schedule is interrupted and a plane must come down elsewhere than at the regular stop, the pilot hands credit checks to the passengers to use on the next Pennsylvania train. Further, he has the privilege of having all but a few extra fare trains flagged to take aboard the stranded air voyagers. So long as present limitations in certain kinds of weather exist, it seems well to realize that the railroads may be the industry's best friends.

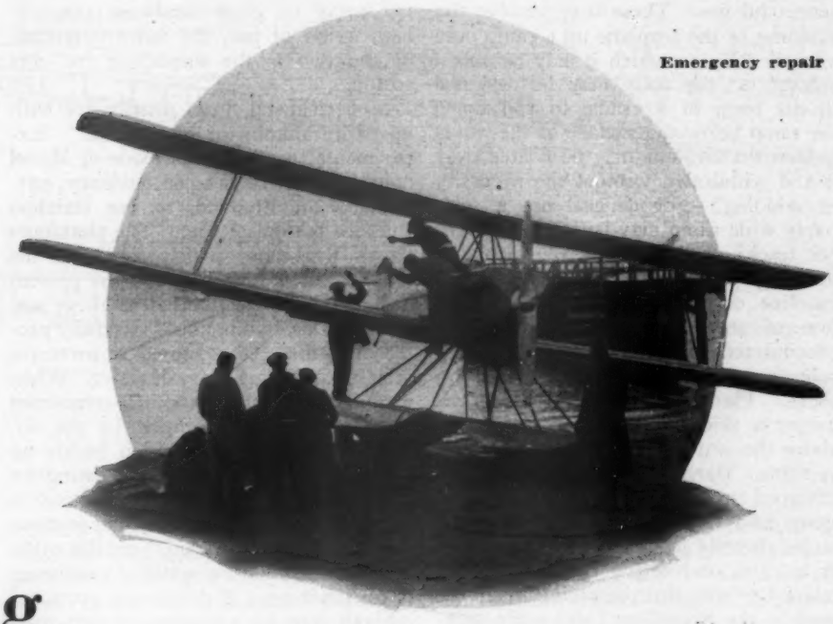
I have not yet mentioned means of letting the world know what service is offered. Of course, there is advertising —paid and otherwise, and solicitation. On the the first, the airlines are rather at a disadvantage because few advertising agencies are adequately prepared to give worth-while counsel. Instead of being ahead of air travel, they are behind. True, aviation has not patronized them extensively, so we can hardly hope for up-to-the-minute service.

On the subject of publicity, or unpaid advertising, I think aviation has grown up and cannot expect any more free space than is accorded other forms of transportation. Accidents will always be news, but they will have less and less effect on patronage. Reports of such mishaps and of the really fundamental changes in the industry, are all that should be counted on extensively, unless at greater and greater expense. Realizing this, the Ludington Line decided to reduce fares instead of increasing advertising, and let satisfied (if possible) patrons broadcast for them. The $20 round trip flight fare compares with $20.04 for rail plus chair between New York and Washington, and the $1.50 added if bus is used in New York does not materially change the total. The average of 60 per cent of capacity load throughout the winter has confirmed the correctness of the decision.

Extra trips for Spring

Reports show 20 per cent more passengers are carried on fair days. With spring coming on, ten additional trips have been scheduled (making 30 altogether) to care for expected traffic after April 1. They are every hour from eight to six, with double sections on the eight, three, four and five from both terminals. To fill this number of seats it may be necessary to do some soliciting, an expedient the company has not yet tried—except in a very limited way by direct mail.

To see the compatibility of low fares and frequent service is not difficult. To see that the public is waiting for the combination at present is not impossible either. Officials of the Ludington Line have for some time patterned their service on both assumptions. To sum up these rambling thoughts it seems that, as I have said in the beginning, a matter-of-fact service is wanted, and the best way of providing that is to fly so that people really save time. A large number of those who travel on NYPWAC are repeat customers, a fact of significance in any transport service. I hope that the next year or two will show general improvement in equipment and methods of operating throughout the country so that all operators can receive adequate returns from the service they eventually will have to give in order to meet public demands for air transportation.

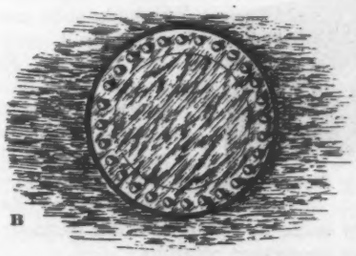


Emergency repair

Some timely pointers on care, maintenance, and procedure for repair of seaplane floats and hulls

Conditioning floats and hulls

A



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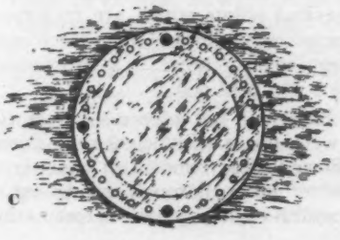


C

Three steps in patching a punctured float. (A) A typical puncture (dotted line shows material to be cut away) (B) Patch held in place with machine screws. (C) Permanent riveted patch.

THE passing of winter and the opening of a new flying season brings to the attention of operators of marine aircraft the problem of putting hulls and floats into proper shape, and of making preparation to protect their equipment against corrosion and minor accident.

Extensive damage to floats or hulls as a result of crashes or collisions at high speed is usually beyond the scope of local repair and frequently means returning an entire unit to the manufacturer for rebuilding. Fortunately, the problems which the average operator must face are not of this character, but he must be prepared to maintain protective coatings and to make emergency and permanent repairs to dents, cracks, or punctures which are not accompanied by extensive deformation of the framework. Since practically all modern floats are of metal construction no attention will be paid in the following discussion to the older wooden types.

The equipment required to lay up seaplanes for repair to floats or hulls depends on the weight and construction of the airplanes to be handled. Certain types may be skidded under their own power up a well greased wooden ramp while others must be floated over a submerged cradle on which they may be drawn from the water. Some floats are equipped with welded-in steel tubes through which a short axle carrying a pair of wheels may be temporarily installed to facilitate handling when out of the water. Aside from the structure of the float bottom, the question of stability enters the problem at this point for it is obvious that a single float seaplane, or center hull flying boat, will require the use of some sort of supporting cradle to prevent its tipping over after the wing tip floats are clear of the water, whereas a twin float seaplane will stand firmly on its own keels. Where temporary use is to be made of a sandy or gravel beach, which slopes at not more than 8 to 12 deg. from the horizontal, a simple plank runway may be used effectively. A variation of this type designed particularly for two float seaplanes consists of a track made up of two timbers set about the distance from keel to keel apart, fastened together with cross ties. Wooden strips may be nailed along the edges of the planks to keep the keels from sliding off the tracks.

For more permanent installation where beach conditions are not good, various combinations of pier and ramp are in

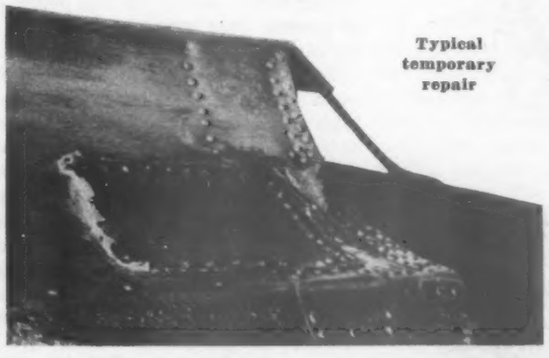
successful use. These may involve the skidding of the seaplane up a ramp onto a small dolly on which it may be pulled ashore, or, the dolly may be designed in the form of a cradle to roll down the ramp below the surface of the water so that the airplane may be floated over it and withdrawn without the necessity of skidding. For general use a relatively wide ramp may be installed without tracks or dollies and the airplanes merely towed up on it by means of a gasoline or electric tractor. A variation of the ramp idea is sometimes encountered in the form of a partially submerged raft or barge anchored off shore. Planes may be moored to the barge, or skidded up its inclined surface above the water line where repairs can be made. Barges of this type have been designed to include shop and hangar space into which the seaplane may be pulled directly from the water by means of tractors or hoisting cables. It is of interest to note that the racing seaplanes used in the Schneider races were serviced on specially designed barges which could be used either as a ramp or as a drydock by flooding or pumping out their stern compartments. The selection of permanent equipment of any type depends largely on topography, tidal levels, etc.

In an emergency, repairs may be made on any shelving beach where the airplane may be drawn out of the water on temporary planks by whatever means may be available at the moment. For single float, or hull types, some form of hoisting device is usually required so that the bottoms may be made accessible. For twin floats, the damaged side may be raised clear of the ground by jacks, and blocked up on horses, boxes, or whatever means is at hand, while the greater portion of the weight is carried by the keel of the undamaged float. Care should be taken that the latter is not resting on anything which might puncture the bottom while in this position.

Launching preparations

The first step in the preparation of a hull or float for relaunching after a prolonged period out of the water is to dry it thoroughly inside and out, and to clean up the interior. Spaces between bulkheads, stringers and plating may have filled up with dirt and it is important that all such material be removed, as it has a tendency to act like a sponge soaking up and retaining moisture and forming a starting point for corrosive action. If the equipment has been greased and oiled before storage, surfaces of all members should be scrubbed with a neutral soap and water to remove the coating. After washing the structure should be rinsed off with fresh water and permitted to dry. The next step is to inspect for loose paint or corrosion, and for mechanical damage. Assuming that the equipment has been put away in good condition after its last period of use, the more important of the two is the inspection for corrosion.

Modern metal floats usually are built up of duralumin, or of "Alclad." Experimental use has been made of Monel metal, and there is some tendency, particularly in England, to use stainless steel for bottom plating. The aluminum alloys are most widely used in the United States however, and the present discussion will be limited to these materials. Duralumin, unless carefully protected at all times, is subject to corrosive attack, particularly by salt water. When manufactured into floats, it is sometimes given protective treatment by the so-called anodic process which builds up a corrosion resisting oxide coating on the surface. The chemical coating is usually further protected by one or more coats of paint. "Alclad," on the other hand, is a composite material consisting of an inner core of duralumin protected on both sides by a continuous thin coating of pure aluminum. The latter is very highly resistant to corrosive attacks and protects the alloy below it. The protective action is electrolytic in nature and affords a certain protection to the underlying alloy even when the latter is exposed at sheared edges, or by mechanical abrasion. "Alclad" is sometimes used without external paint coatings although it is more commonly the practice to protect the metal further with an undercoat of bitumastic paint or red lead, and a top coat of aluminum, or other lacquer. During construction all faying surfaces of pontoons or hulls should be liberally coated with marine glue or bitumastic paint before assembly regardless of the material used.



Typical temporary repair

If preliminary inspection indicates that protective coatings have broken down, either from chemical action or mechanical abrasion, immediate steps should be taken to restore them before dangerous deterioration sets in. If corrosive action is already under way, it will be evidenced by the appearance of faint white spots, resembling snow flakes in shape and size, which, in the more advanced stages, show a distinct deposit of a white powdery substance. Careful distinction should be made between actual corrosive spots and mere deposits of salt or barnacles. The latter are formed outside the paint and can be easily washed away, whereas the true corrosion occurs underneath the paint and causes it to flake off.

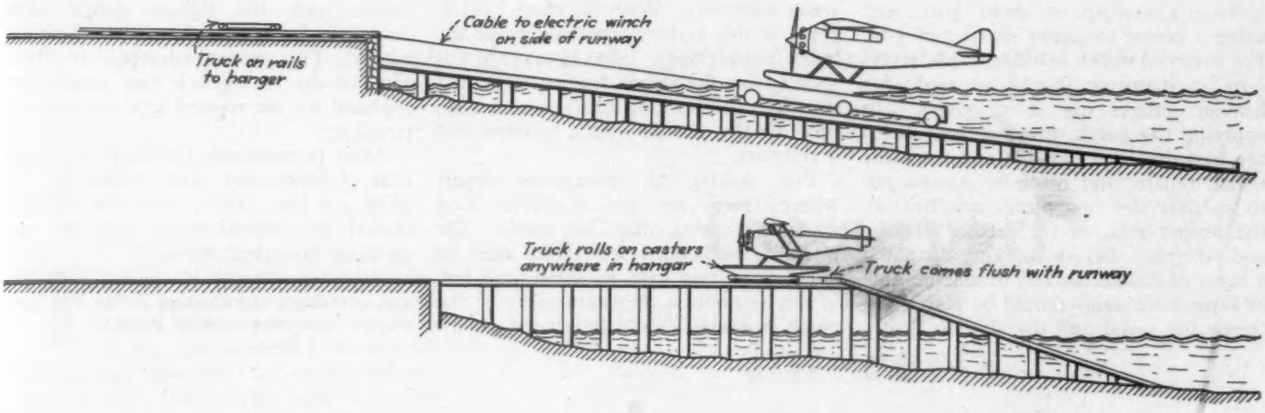
Wherever corrosion spots are located any deposit should be very carefully scraped off using a dull putty knife, or a stiff fibre brush. Wire brushes or sharp metallic scrapers should be avoided as there is great danger of removing the anodic coating from duralumin or the pure metal coating from "Alclad." Brushing or scraping operations should, in any case, be confied to a limited area surrounding the corroded spot. After all loose material has been removed a new protective coating must be applied to the exposed surface. If the trouble is in the interior of a float, several coats of bitumastic paint will suffice; if on the outside, a coat of bitumastic paint or red lead, followed by a suitable finishing coat should be applied.

Painting rules

After all evidences of corrosion have been corrected, it may be desirable to refinish the exterior surfaces completely. Old paint may be removed by the use of a suitable chemical paint remover. In selecting a remover of this type, however, care should be taken to use one of a rather thick, jelly-like consistency rather than a thinner type as there is always the danger that the latter will enter into joints in the structure and damage the paint or sealing compound in them. In removing paint from aluminum material, it must also be remembered that a substance which contains strong caustic compounds should not be used, as it will attack the metal. Removal of the paint after softening should be done very carefully with a scrubbing brush or dull putty knife in order to avoid damaging other protective coatings.

In painting metal surfaces of any kind, particularly boat structures, there are several points which are frequently neglected or overlooked, but which must be kept well in mind if a satisfactory job is to be obtained.

1. Paint will not adhere satisfactorily to a wet surface. Sufficient time should be allowed after removal of boats from the water for a thorough drying out of the water-soaked paint before other


Cable to electric winch on side of runway
Truck on rails to hanger
Truck rolls on casters anywhere in hangar
Truck comes flush with runway

Two practical types of seaplane ramp

coats are applied. Several hours are required for drying water-soaked paint properly.

2. Fresh coats should not be applied on top of old paint which may have blistered.

3. Paint will not adhere to a dusty or greasy surface.

Under coats should consist of at least one coat of either red lead or bitumastic paint, depending on whether the metal is "Alclad" or anodically treated duralumin. For finishing coats an aluminum lacquer is often employed, or any other water-resisting paint may be used to conform with the desired color scheme of the airplane involved. For interiors, bitumastic paints or red lead should be liberally applied.

Minor leaks in floats or hulls may be readily detected by introducing fresh water into the various compartments and watching the outside of the hull for any appearance of moisture. Particular care should be taken, however, when making tests of this kind that the hull is well supported on the outside, particularly in that portion aft of the step. If this precaution is not taken the weight of the water inside may be sufficient to cause permanent damage to the structure, necessitating its complete rebuilding.

Unless the skin has been damaged, most leaks occur around rivets. A loose rivet may be tightened by repointing with a hammer and rivet set, but occasionally a new one will have to be inserted. When one or more rivets are removed it is a good idea to introduce bitumastic paint, red lead, or marine glue into the seam and around the holes before redriving. Careful watch must be kept of any sources of leakage other than in the hull plating, as water may enter through defective hand-hole gaskets, vent holes, etc. All gaskets should be replaced as soon as they show signs of deterioration. Vent holes should never be permanently plugged, as their function is to relieve pressure differences between the interior of a float, and the atmosphere due to changes in altitude. Leakage from this source may be reduced by filling the holes with a thick soft grease which will be blown out whenever the pressure differential becomes too great. Under certain atmospheric conditions moisture may be introduced into floats by condensation or "sweating," and it should be definitely ascertained that this is not the cause of the apparent leakage before proceding with further tests.

With corrosive spots checked and with fresh protective coatings outside and inside, the equipment is ready for service. It must not be assumed, however, that coatings, no matter how fresh, will last indefinitely without attention. Frequent exterior and interior inspection should be made and the coatings renewed at any point which show signs of failure from any cause. In this connection the old saying that "an ounce of prevention is worth a pound of cure" is excellent advice, and the operator who goes to the time and trouble necessary for frequent periodic inspection will be well repaid in length of life of his equipment.

Tears and punctures

A totally different type of servicing is made necessary by a seaplane striking floating objects on the water, or being badly handled while drawn up on shore. Damage of this sort is usually in the form of tearing or puncturing the skin and must be repaired by the proper application of patches. The tools and materials for patching an ordinary metal hull are very simple and the average intelligent mechanic can readily acquire the knack of making repairs of this sort. The necessary tools include a drill, a hacksaw, a file, a wooden mallet, a hammer, a small cold chisel, a tool for backing up the rivets, and a rivet set. The materials usually required are a piece of duralumin or "Alclad" sheet, duralumin rivets, machine screws, some friction tape or flannel cloth, and marine glue. In no case should brass or copper rivets be used, as the electro-chemical reaction of these materials with aluminum will accelerate corrosion very materially.

Except where they occur in the bottom portions of float, just forward of the step, where the shape of the bottom is an important factor in the take-off characteristics, small dents in the metal are not serious, and, for the most part, should be left alone. More deeply dented portions of the skin may be hammered back into shape by placing a flat piece of wood behind the bent part and hammering on the projecting material with a wooden mallet. It must be remembered, however, in making repairs of this sort that deformation without subsequent heat treatment tends to harden and embrittle the metal. Where the deformation has been relatively great, or where dents have produced very sharp bends, it is best to reinforce the surrounding area with a patch after the dent has been flattened out even though the process has been accomplished without any apparent cracking.

Where the skin has actually been broken or where cracks have been introduced from straightening operations a patch should be applied as soon as possible. Before beginning this operation, however, the region of the damage should be very carefully examined for small cracks radiating from the actual break. For this purpose, it is essential that the paint be removed from a sufficiently large area surrounding the damage to afford thorough inspection. With shears or hacksaw, all the damaged portion should be carefully cut away to leave a symetrically shaped hole with sound metal all the way around. Edges should be carefully smoothed down with a file. Where the hole extends over existing rivets, the heads should be cut off and the shanks knocked out with a punch.

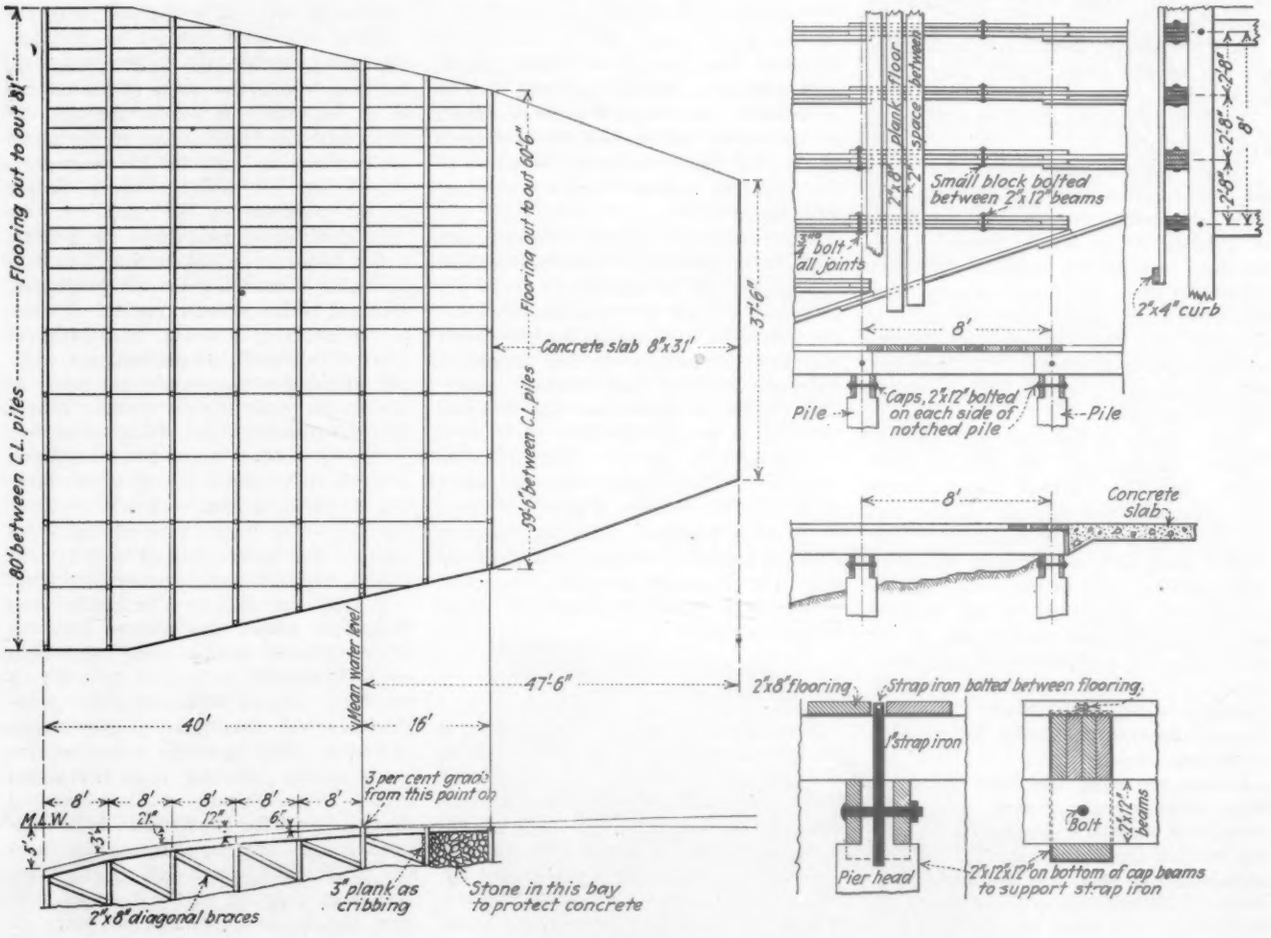
After having cleaned up the damaged area as described, the next operation is to cut out a patch from duralumin or "Alclad" sheet large enough to overlap the edges of the hole by at least ½ in. all around. Sheet one or two gauges heavier than the damaged material should be selected. A row of rivet holes should then be laid-out around the edge of the patch with a center punch,

leaving a margin of about $\frac{1}{4}$-in., and using a center to center spacing of $\frac{3}{8}$-in. For material under .0040-in. thick, rivets $\frac{1}{8}$-in. in diameter should be used; for heavier gauges use $\frac{3}{32}$-in. rivets. In applying the patch, three or four holes are first drilled through it and the piece under repair, and machine screws put in so that the two pieces are held in the proper relation for further drilling and riveting. Before applying the patch a layer of flannel soaked in marine glue or bitumastic paint should be placed between the metal and the skin to insure water-tightness. With the patch held in place in this fashion, the balance of the holes are drilled. The rivets are inserted from the inside, backed up with a iron bar (or bucking tool), and headed up from the outside with a hammer and a rivet set.

For making an emergency repair where rivets are not available, steel machine screws may be used. The pitch recommended for rivets may be doubled in this case to save time but, if this is done, a duplicate piece of the patch material should be placed on the inside with the lighter gauge skin clamped between the two heavier pieces. This method of repair is effective in an emergency but should be replaced by the riveted type as soon as possible.

After permanently patching, a liberal coat of bitumastic paint should be applied on the inside, and the outside should be refinished by one of the methods described above.

Note: Illustrations for this article furnished through the courtesy of the Edo Aircraft Corporation, College Point, N. Y.



A design for a seaplane ramp

IN the course of a 5,000-mi. cruise around the Great Lakes last summer in amphibions and seaplanes, Mr. Wayne J. Sheldon, president of the Detroit Flying Club, found a decided lack of facilities for taking care of such aircraft. When approached on the subject, many city officials expressed their willingness to built ramps at suitable locations if they had some sort of construction drawings available to indicate how they should proceed. As a result of this experience, Mr. Sheldon, in co-operation with the aviation department of the Standard Oil Company of Indiana has drawn up a design for a ramp which may be varied to suit local conditions. It is not guaranteed in any way, but it has been stressed, according to the designers, to carry a load of 5,000 lb.

Information with regard to the material or construction may be secured by addressing the Aviation Department of the Standard Oil Company of Indiana, Box No. 1176, Detroit, Mich.

A review of the third annual airport conference at Tulsa

The airport interests talk things over

THE third annual national airport conference, held at Tulsa March 25-27 under the auspices of the Aeronautical Chamber of Commerce, was the most successful of the series. Comprising airport managers, engineers, equipment manufacturers, underwriters, and others concerned with airport problems, the group considered most of the phases of the modern port and made definite recommendations — some affecting directly other branches of the industry—which should result in some important advances.

Making the airport pay is, of course, the pressing problem for most operators. About the only exception is a municipal airport considered to be a public necessity, like a park or harbor development. W. Sanger Green of Central Airport, Camden, N. J., described methods of exploiting concessions at a commercial port. Last year 45 per cent of the revenue at Central was derived from concessions and non-flying activities. It is unusually favorably located to cultivate these sources of revenue. Flying brought in only 12 per cent of the revenue, gasoline and oil sales 13 per cent, rentals 25 per cent, and interest 2 per cent. It is expected that Central will derive at least 50 per cent of its income from concessions this year. Among its non-flying attractions are ten automobile service stations, a swimming pool, restaurant, and two miniature golf courses. Fence advertisements are contemplated.

Capt. Roy N. Francis of the San Francisco Municipal Airport represented the opposite point of view. As an air harbor and a convenience to the flying public the airport should be adapted as far as possible to the best interests of its users, though this mean a slight loss. Various methods of building up the airport revenues were discussed, but it was apparent that individual characteristics of location, terrain, and local interest, precluded general rules or recommendations. It was agreed, however, that commercial and municipal ports essentially have two very distinct points of view and that it is imperative the municipal port take into consideration the position of the commercial fields, especially those in the same locality, when establishing rates and practices.

Fred E. Schnepfe, special research engineer for the Aeronautics Branch, warned that in designing airport surfaces more careful attention must be given such factors as relative use of tail skids and tail wheels, landing and take-off speeds and weights of future transport types, action of tires, and new shock absorbing devices. Trends in airplane designs must be watched because of their inevitable influences upon airport engineering. The airport managers in their private meeting recommended that tail skids be eliminated entirely, and Jan. 1, 1932, was suggested as the date for this to take effect. A higher storage rate for planes with skids was also proposed as a means of encouraging wider use of wheels.

Traffic control

A discussion of traffic control at airports and uniform field regulation was lead by A. Pendleton Taliaferro, Jr., chief of the Airport Section, Aeronautics Branch. The managers agreed that development of some uniform mechanical traffic regulation device is urgent, and appointed a committee to work with the Branch in the development of a solution. Uniform field regulations are to be considered seriously, also, but no committee has been appointed to handle this matter.

The perpetual controversy over hangar sprinklers flared up again. Fire control is a vital subject, and the airport men showed their appreciation of its magnitude. From the comments made by managers, sprinkler manufacturers, underwriters, and airline operators, a number of important points developed: that thorough training in the use of fire equipment should be encouraged; that sprinklers of one type or another are valuable if they can be afforded, or if water pressure is available; that airports, rather than insurance companies, are making the insurance rates through their own success in handling the problem; that more intelligent care should be exercised in handling dope; that manufacturers of aircraft can help considerably by improving electrical installations in planes and by improving design and location of fuel tanks; that smoking should be prohibited without exception in hangars; and that hangars should be kept scrupulously clean.

Uniform storage charges

The managers approved the Aeronautical Chamber's proposed schedule of uniform airplane storage charges and will follow as closely as local conditions permit. This schedule classifies planes in nine groups according to wing span. Class 1, for instance, includes machines with a span of 30 ft. or less at a rate of $2 per day, and Class 9 includes machines with span of 100 ft. or over at a rate of $10 per day. Monthly rates would be 50 per cent of the above and dead storage would be 75 per cent of the daily rates. Inspections and servicing are not covered by these fees. A new classification is being worked out to care for the very light type now making its appearance.

The state aviation officials in their private meeting resolved that: the federal regulations be adopted by the states for the sake of uniformity; that there be no tax on aviation gasoline unless it be devoted to aeronautical purposes; that there is need for state legislation regarding air rights over land; that identified planes be eliminated as far as possible; and that serious study be given the advisability of making easier the requirements for the private pilot.

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Heat and Ventilation

Their place in the transport plane

ARTICLE ONE

By E. C. Blackburn, Jr.
Consulting Engineer

MAINTENANCE of satisfactorily comfortable conditions to meet the exacting requirements of the modern traveling public in large passenger carrying airplanes is dependent on a great many separate and distinct factors. The aircraft manufacturer will not have to be the one to listen to the tales of woe of complaining passengers. It is the operator of the air transport line who must bear the brunt of this. It is true that he will pass the complaint on to the manufacturer but it will, in most cases, be tempered by a certain amount of understanding of the problems which the manufacturer faces.

Nevertheless, when he is in the market for additional planes, other things being equal, he will select those which are equipped with adequate heating and ventilating systems. He positively must have planes that are so equipped, even at a sacrifice of pay load, or else see passengers embark joyfully and in good spirits, but disembarking at their destinations in a very unfavorable frame of mind, and probably thinking either audibly or to themselves, "Never again."

Speed is important. But it is not always the deciding factor when the public is traveling. It is probable that speed, combined with luxurious accommodations always will determine what means of transportation will be selected by a traveler.

Pay load and economical operation are important but only to the operator. The passenger doesn't care whether the operators profit is satisfactory or not. All he wants is to get from here to there as rapidly, comfortably, and pleasantly as possible at a minimum cost.

Railroads are constantly reducing schedules and increasing the luxuriousness of the accommodations they have to offer in order to meet competition successfully; steamship lines are constantly building faster and more luxurious ships to compete successfully in their field; bus manufacturers are continually designing and building larger, faster, and more comfortable coaches. Is there any reason then to suppose that the same conditions will not prevail in the air transport field?

Railroads, steamship and bus lines strive for the maximum efficiency without decrease in passenger comfort. Their first consideration is luxurious passenger accommodations. Attaining the maximum in this respect, they then turn their attention to realizing the highest efficiency possible under these conditions.

Sacrificing pay load

The majority of airplanes manufactured today carry pay loads that are surprisingly large in comparison with their weight and power. This has been accomplished by engineering methods which are perhaps more accurate and more painstakingly worked out than those in any other branch of engineering.

A small proportion of this pay load might well be sacrificed for the furtherance of passenger comfort without undesirable consequences. Even though the pay load and consequently the cash return per trip was somewhat reduced, it would be found to be a profitable step in the long run due to satisfied patrons continuing to travel by air rather than trying it once and then going back to a slower but more comfortable means.

If the weather suddenly turns cold and the heating system is inadequate, or if the air in the cabin is bad and odors are prevalent, the air traveler will immediately forget all the efforts which have been made to provide for his comfort and will dwell exclusively upon the one uncomfortable feature—inadequate heat, poor ventilation, or both.

Thus a passenger carrying airplane can be placed in the same category with all classes of buildings, railroads, steamships, and buses, in this respect: regardless of how fine and beautiful they made be, none of these things will be any more satisfactory than their heating and ventilating systems. This is due to the fact that there is no one thing which plays a more important part in the health and comfort of the human being than the proper amount of heat and good air conditions.

The first step in designing any heat-

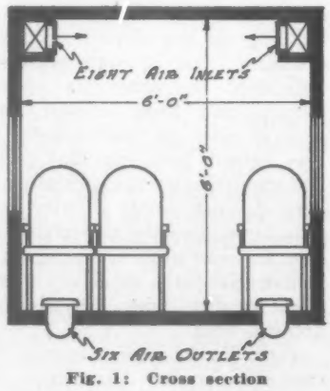


Fig. 1: Cross section

A hypothetical cabin with an adequate heating and ventilating plant

So engrossed is the aeronautical engineer with the problems of trimming structure weight to a minimum and increasing pay load and performance, that the comfort of passengers in transport planes is all too frequently neglected. One of the most important factors contributing to passenger comfort is adequate heating and ventilation. In this, the first of two articles, Mr. Blackburn, who is a specialist on the subject, presents his opinions together with data for the design of an efficient heating system for a typical transport plane.

ing system, regardless of type, is to determine the total heat loss from the space, or spaces to be heated. Having determined the total heat loss from these spaces, the designer can then proceed with the determination of the type of heating system best suited to overcome these conditions.

After the total heat loss has been determined, the question of the amount of air to be supplied and exhausted for ventilation must be determined. It remains then for the designer to plan a system that will supply an amount of heat equal to, or slightly in excess of, the heat loss from the spaces to be heated, plus the amount necessary for warming the ventilating air to the proper temperature.

A great many considerations enter into the decision as to what type of system will supply most satisfactorily the necessary quantity of heat for any given installation. In designing a system for a cabin airplane, weight of equipment is of great importance. The weight of the system must be reduced to the minimum. But this should not be carried to such an extreme that the system cannot function in a proper manner. Neither should it be carried to such an extreme that the system will deliver just enough heat to "get by."

More will be said on the subject of weight later in connection with the discussion of the various types of heating systems which are available.

Determining heat loss

In determining the heat loss from a cabin there are several things to be considered. The heat loss from any space depends upon the material and thickness of walls, floors, ceilings, total area of windows and doors, exposed to outdoor weather conditions, and infiltration. It is dependent also upon the difference in temperature between the minimum outdoor temperature for which the system is designed, and the temperature it is desired to maintain within the cabin.

Various types of material will have varying rates of heat transmission per inch of thickness. These rates of trans-

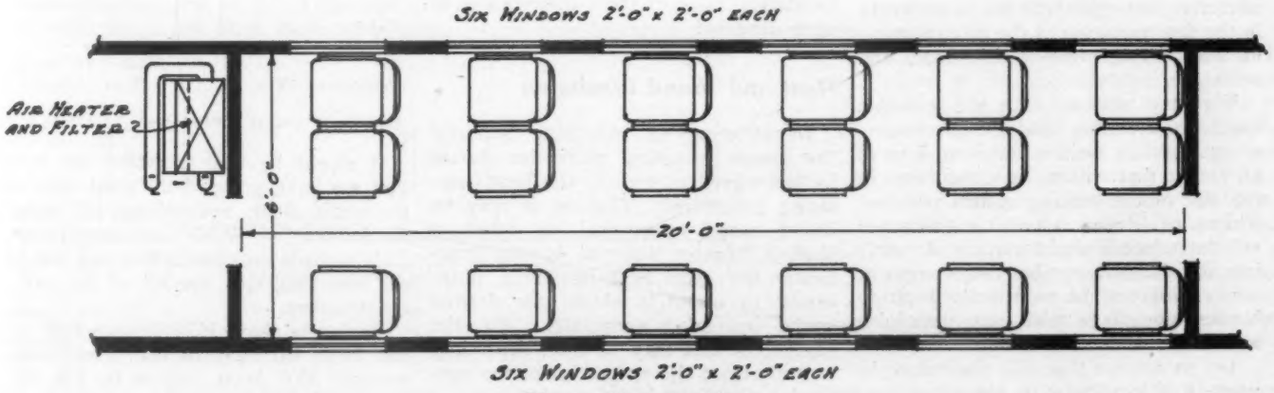


Fig. 2: Plan of cabin

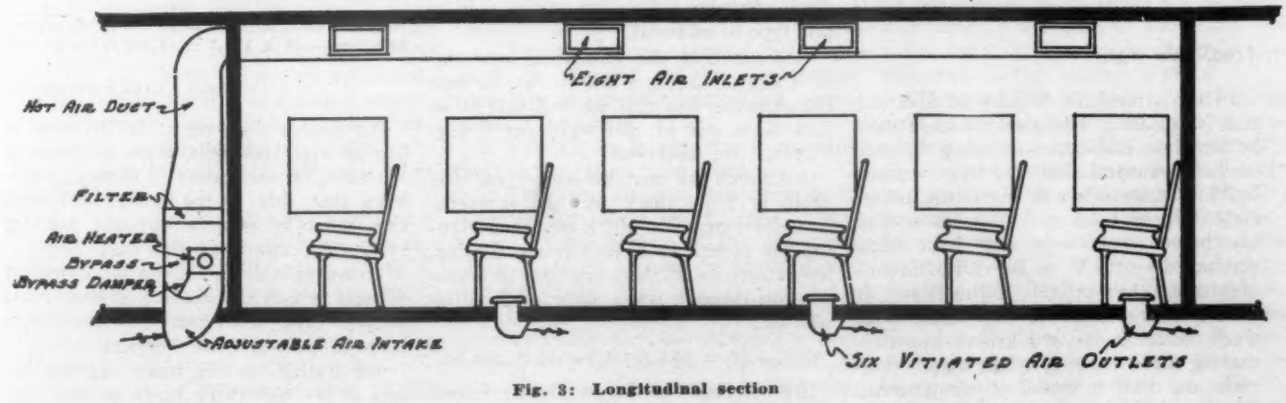


Fig. 3: Longitudinal section

mission can only be determined by actual test. Such tests have been made by various authorities for a great many different heat insulating materials that are now on the market. Many of these heat insulating materials are also very good sound insulating materials and some are quite light in weight.

This is a very fortunate coincidence for the reason that a manufacturer who is using liberal amounts of sound insulating material will automatically be reducing the size and weight of the heating system which must be installed.

Our discussion will probably be simplified somewhat if we assume a hypothetical cabin and design a heating and ventilating system for it. Let us assume that this cabin is as shown in Fig. 1, 2, and 3.

We will assume, for the sake of brevity, that the walls, floor, and ceiling of this cabin are all constructed of the same material and are of the same thickness. Thus the rate of heat transmission will be the same through all of them. This construction we will assume to be as shown in Fig. 4.

At the present time no data is available on the rate of heat transmission through doped fabric, so until some tests have been made to determine this, any figure adopted for fabric covering must necessarily be purely an estimate. It is certain that this rate of heat transmission will be very high. Therefore, in the interests of safety, it would seem advisable to neglect the fabric covering in the determination of the rate of transmission through the walls, floor, and ceiling.

We may assume, with a reasonable degree of certainty, that the fabric covering will not reduce the heat loss to an extent that will make a reduction in the size of the heating system possible. Therefore, if we neglect it entirely, we will introduce a slight margin of safety into our calculations, but this margin of safety will not be sufficiently high to burden the plane with any noticeable amount of additional weight.

Let us assume that this plane is to be used in a locality with minimum temperatures of 20 deg. below zero F. during the winter and that we must maintain a temperature of 70 deg. F. inside the cabin under these conditions.

Available data

In the American Society of Heating and Ventilating Engineers' Guide may be found several tables showing the rate of heat transmission through various building materials and insulating materials. These rates of heat transmission are based upon tests that have been conducted by the U. S. Bureau of Standards and other reliable authorities. It should be remembered that these tests were made under conditions approximating those existing when these materials are used in building construction. The results may or may not hold true when the same materials are subjected to conditions encountered in connection with their use in aircraft. However, it is probable that they may be safely used until such time as more information is available pertaining to their properties when used in aircraft.

Fortunately for the aircraft industry, a study of these tables reveals the interesting fact that the insulating materials that are lightest in weight have the lowest rate of heat transmission. For example:

Dry Zero, which is composed of kapok between burlap or paper, weighs 1 lb. per cu.ft., and transmits heat at the rate of 0.24 B.t.u.'s per hr. per sq. ft., per 1 deg. F., per 1 in. thickness.

Cabots quilt, composed of eel grass between Kraft paper, weighs 3.4 lb. per cu.ft., and transmits heat at the rate of 0.25 B.t.u.'s per hr. per sq.ft., per 1 deg. F., per 1 in. thickness.

Balsam Wool, composed of chemically treated wood fiber between layers of paper, weighs 2.2 lb. per cu.ft., and transmits heat at the rate of 0.27 B.t.u.'s per sq.ft. per hr., per 1 deg. F., per 1 in. thickness.

Compare these values with white pine, having a weight of 31.2 lb. per cu.ft., and a rate of heat transmission of 0.78 B.t.u.'s per hr. per sq.ft., per 1 deg. F., per 1 in. thickness, and the high heat insulating value of these materials is at once apparent.

Heat and sound insulation

In selecting an insulating material the sound insulating properties should be considered as well as the heat insulating properties. That is, it may be found more economical to select a slightly heavier material having practically the same heat insulating properties, in order to obtain the desired sound insulating properties. Or, the reverse of this may be true, depending entirely upon the properties of the particular material under investigation.

There are many of these materials on the market and those mentioned above have merely been picked at random to show approximately what is available in this type of material.

Assume that the insulating material is of a type having a known rate of heat transmission and that we find this to be 0.34 B.t.u. per hr. per sq.ft. per 1 deg. F. per 1 in. thickness.

Inasmuch as our insulation on this cabin is 1 in. thick and the temperature difference for which we are designing the system is 70 deg. minus 20 deg. below zero or 90 deg., our rate of transmission through walls, floor, and ceiling will be:

$$90 \times 0.34 = 30.6 \text{ B.t.u. per sq.ft. per hr.}$$

By reference to the result of tests we find that the rate of heat transmission through the windows is 1.13 B.t.u. per hr. per sq.ft. per one degree F. difference in temperature. Thus for our cabin windows the rate of heat transmission will be:

$$90 \times 1.13 = 101.7 \text{ B.t.u. per sq.ft. per hr.}$$

In referring to Figs. 1, 2, and 3, it is apparent that we will have two exposed walls whose areas will be 6 ft. 0 in. × 20 ft. 0 in. minus the area of the windows, one exposed floor 6 ft. 0 in. × 20 ft. 0 in. and one exposed ceiling the same as the floor. It is also apparent that we will have twelve windows each 2 ft. 0 in. x 2 ft. 0 in.

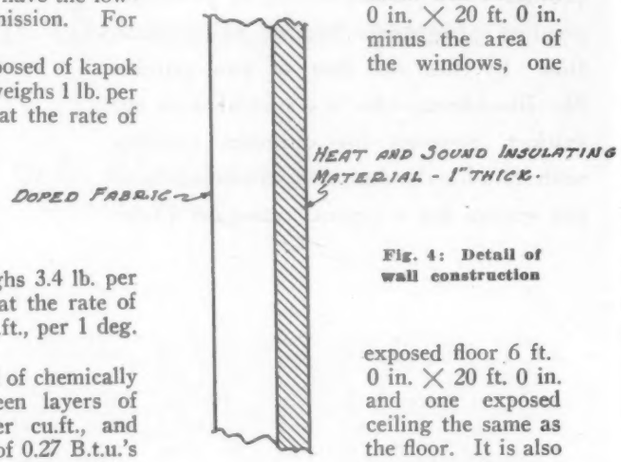


Fig. 4: Detail of wall construction

The areas of exposed wall, floor, ceiling, and windows upon which we must base our heat loss calculations are:

Walls—2 × 6 ft. × 20 ft.	=	240 sq.ft.
Floor—6 ft. × 20 ft.	=	120 sq.ft.
Ceiling—6 ft. × 20 ft.	=	120 sq.ft.
Total		480 sq.ft.
Windows—12 × 2 ft. × 2 ft.	=	48 sq.ft.
Net wall (Wall—Windows)		432 sq.ft.

It might be well to point out here that we have grouped the total area of the walls, floor, and ceiling, all under the heading of "Wall" for convenience. This is made possible in this case due to the fact that they are all of the same construction.

From the above it is obvious that we will have 432 sq.ft. of wall area transmitting 30.6 B.t.u. per sq.ft. per hr., and 48 sq.ft. of window area transmitting 101.7 B.t.u. per sq.ft. per hr. Our total heat loss from the cabin then will be:

Wall	—432 × 30.6 =	13,219 B.t.u. per hr.
Window—	48 × 101.7 =	4,882 B.t.u. per hr.
Total		18,101 B.t.u. per hr.

As this is the rate at which heat is lost through the walls, floor, ceiling and windows of the cabin it naturally follows that this is the amount of heat that must be supplied by the heating system to counteract this loss.

However, this is not the total amount of heat which the heating system must supply. We have not yet taken into account infiltration or ventilation.

Infiltration, as the name implies, refers to the air which finds its way into the cabin through cracks around win-

dows, doors, etc. The determination of this quantity of air entering the cabin from this source with any degree of accuracy is indeed very difficult. Both the design of the window and door installation of the cabin, together with the class of workmanship, must enter into any estimate of the rate of infiltration. These are admittedly very difficult matters to which to assign any definite value.

By way of illustrating the large volume of air that may enter the cabin by way of minute cracks and crevices we can only refer to tests that have been made on windows used in building construction.

Again referring to the American Society of Heating and Ventilating Engineers Guide, several tables may be found wherein data are given on the leakage per foot of crack around windows of various types, under various wind velocities, 50 m.p.h. being the maximum velocity given.

These tables show that as high as 488 cu.ft. of air per hr. per ft. of crack may enter around a reasonably tight fitting wood sash, with a wind velocity of fifty m.p.h. Multiply this figure by the number of feet of crack around the window and the figure mounts to a considerable quantity of air.

Increase this figure again for the higher velocities encountered in aircraft, bear in mind the fact that this air will bring discomfort to the passengers, and will increase the load on the heating system to a very great extent, and the importance of constructing air tight cabins is obvious.

If infiltration is to be considered in the design of the heating system then the amount of air entering the cabin from this source must first be estimated. After this is found it is a simple matter to determine the amount of additional heat that must be given off by the heating system to cope with the infiltration of cold air.

In a properly designed ventilating system, provision can be made for reducing infiltration to a point where it is no longer of sufficient importance to warrant its consideration in connection with the heating system. This is by far the most satisfactory method.

Again, if infiltration is stopped by means of the ventilating system, objectionable drafts of cold air will not be in evidence. We will assume that in the design of our ventilating system for this airplane cabin we are going to make provision for reducing infiltration to the minimum.

We have now gone as far with the design of the heating system as we can without considering the ventilating system in so far as it affects the heating system.

Referring to Fig. 2 it will be noted that there are chairs for eighteen passengers in the cabin. Thus we must provide adequate ventilation for this number.

In school class rooms and many other rooms where a number of people gather it is, in many cases, customary to provide a room volume of 200 cu.ft. per occupant. In some localities ordinances are in force which require this as a minimum. In the average airplane cabin this volume per occupant is very materially reduced, probably averaging approximately 50 cu.ft. of cabin space per occupant. I mention this merely as one of many reasons for the necessity of very adequate cabin ventilation.

Only a small quantity of air is actually necessary to supply the needs of the human lungs. A much larger quantity is necessary, however, for the adequate removal of body heat, moisture, odor, etc.

A successful ventilating system must satisfy most of the following requirements:

1. It must be capable of delivering to the occupants of a given space a volume of air entirely sufficient for all their requirements.

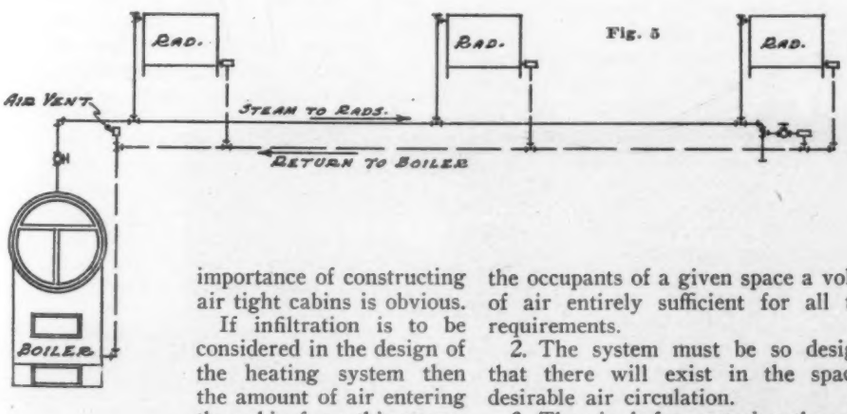


Fig. 5

2. The system must be so designed that there will exist in the space a desirable air circulation.

3. The air, before entering the space, must be changed to the temperature necessary to produce comfortable conditions in the space.

4. The air to be used for ventilation must be free from odors, dust, etc.

5. The ventilating system must be so designed that there will be equal distribution of the air to all the occupants of the space. This must be accomplished without drafts.

6. Control of relative humidity is very advisable but not absolutely necessary. It is almost impossible of accomplishment in airplanes at the present time. Satisfactory results, however, can be obtained in most cases without humidity control.

The air volume to be supplied is the first feature of the ventilating system that must be determined. In most school and theater ventilating systems it will be found that in the neighborhood of 30 cu.ft. of air per min. per occupant is considered the most desirable amount.

Bearing in mind the much greater room volume per occupant in these types of buildings compared with the volume per occupant in an airplane cabin it is obvious that this should be considered the minimum for airplane ventilating systems. Supplying 30 cu.ft. of air per minute per occupant in our cabin would require a total of 18 x 30 c.f.m. = 540 c.f.m.

This is really a very small volume of air and will not require ducts that are excessive in size or weight.

The second requirement of the ventilating system as listed above can only be satisfied by the proper size and location of the air inlets and outlets.

The third requirement is the only feature of the ventilating system that will affect the design of the heating system.

The heating system

Before continuing the discussion of the other details of the ventilating system we will consider the various types of heating systems and determine the extent to which our heating system will be affected by the ventilating system.

Generally speaking there are three types of heating systems in common use today. These are designated in most cases by the nature of the heating medium used in them. They are: hot-air, steam, and hot-water.

The hot-air systems may be either gravity or forced circulation and may or may not be ventilating systems in addition to heating systems. The gravity circulation systems require the use of very large ducts so that the resistance to the flow of air will be kept to a minimum.

In forced circulation hot-air systems centrifugal type fans are usually used to create the rapid and positive circulation. This more positive and rapid circulation makes possible a substantial reduction in the size of the ducts, besides resulting in an increase in the efficiency of the heating surface.

The usual hot-air heating system, as well as the combined heating and ventilating system, consists fundamentally of a heated surface over which the air is passed raising the temperature to the required degree. To this heating surface a system of ducts is connected for conveying the air to the hot air inlets. Another duct system is connected to the inlet side of the heating surface. In the case of a heating system only, this duct system returns the air from the room to the heater where the temperature of the air is again raised to the

required degree and it is then delivered again to the room. This recirculating process continues as long as the system is in operation.

In the case of the combined heating and ventilating method the system of ducts for returning the air from the room to the heater is replaced with a fresh air intake which is connected to the inlet side of the heating surface by a duct. In addition to this there must be provided a means of escape for the air after it has performed the functions of heating and ventilating the room.

The hot-air heating and ventilating system has several advantages when considered for use in airplane work. Among these advantages may be mentioned light weight, simplicity, and ease of operation.

A steam heating system consists, fundamentally, of a boiler for generating steam, radiators located at points where heat is required, and a system of supply and return piping for conveying steam to the radiators, and returning the condensation from the radiators back to the boiler. In the boiler this condensation is again converted to steam and the cycle repeated. A diagrammatic representation of such a system is shown in Fig. 5.

There are a great many different systems of piping that can be arranged. In the better grade of installations, however, the one shown in Fig. 5 is the most commonly used and will give very good satisfaction.

In considering a steam system for use in an airplane cabin it should be remembered that the boiler required for generating steam will not be anywhere near the size and weight of the boilers commonly installed in buildings.

Radiator arrangement

There is, however, one feature of a steam system which cannot be avoided. That is, radiators must be distributed throughout the cabin in such a way that an even temperature will exist in all parts of the cabin. If a radiator is located at one end of the cabin only, the other end of the cabin will most certainly be much colder.

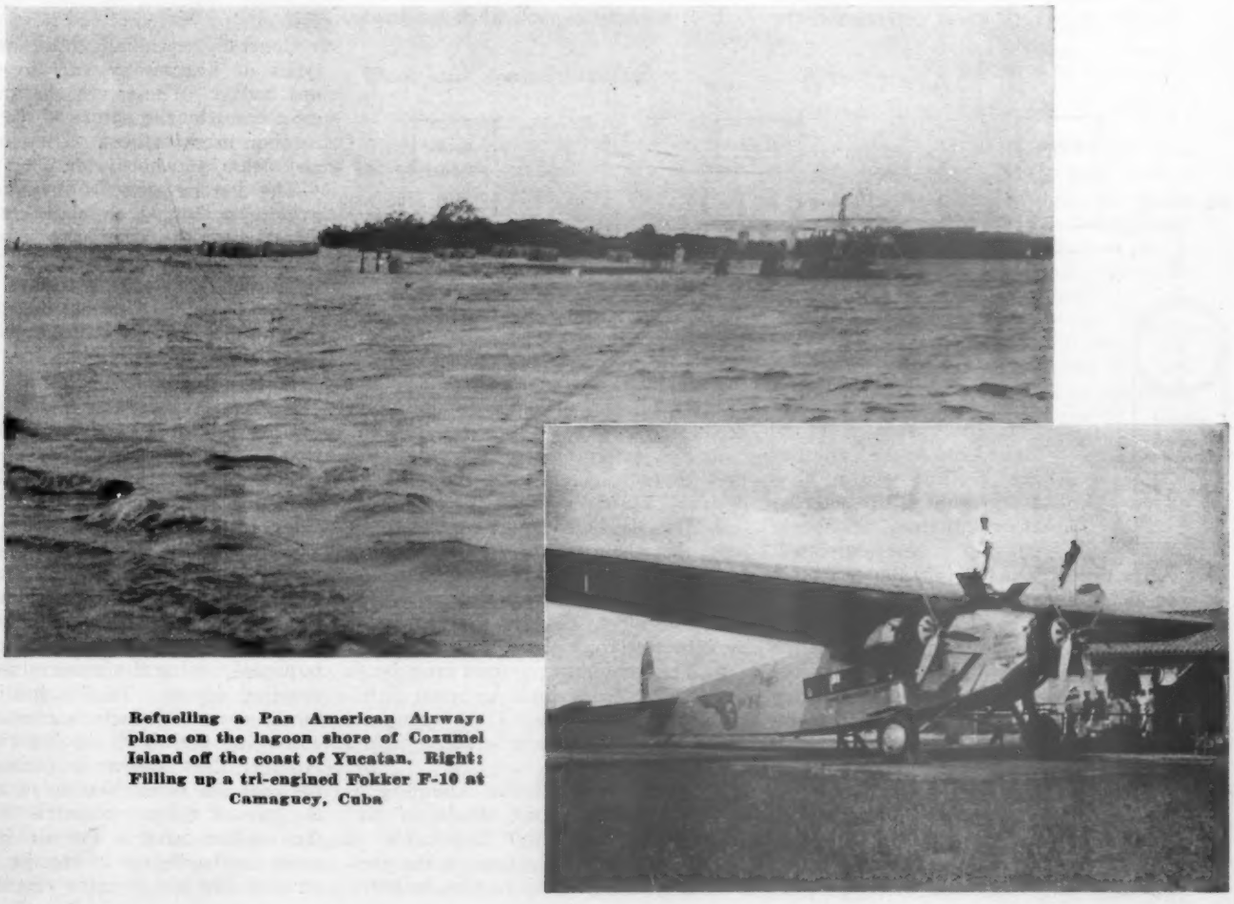
Again, there is a certain definite limit to the amount of heat that can be obtained per square foot of radiation, therefore the radiators cannot be reduced in size, beyond the requirements determined by the heat loss from the cabin without impairing the system.

The only method by which radiator sizes may be reduced is by increasing the temperature of the heating medium. In the case of a steam system this may be done by increasing the steam pressure. This will in turn increase the weight of the radiators, piping, and boiler, as heavier material must be used to contain steam safely at high pressures.

The use of high pressure steam in an airplane cabin seems to me to be most undesirable. First, any actual saving in weight of the system seems to be very dubious. Second, and probably most important, it is not hard for anyone familiar with high-pressure steam to imagine what conditions are likely to be in the confined space of an airplane cabin if a high-pressure steam line should burst.

The argument may be advanced that a system has been tested under a pressure of many times that at which it is to operate without showing any leaks or tendency toward rupture. This is very well when the system is new. But who can say what the condition of the metal of which the system is constructed will be after it has been in operation for a time?

It is certain that pipes and steam generating apparatus in buildings are not immune from failure due to undetected interior corrosion.



Refuelling a Pan American Airways plane on the lagoon shore of Cozumel Island off the coast of Yucatan. Right: Filling up a tri-engined Fokker F-10 at Camaguey, Cuba

Tropic fuelling

A wide variety of methods are used by Pan American

Transporting gas to the field by the use of ox carts

THE heterogeneous conditions obtaining along its far-flung tropical airways system has forced Pan American Airways to provide a wide variety of fuelling facilities. Conventional airports or landing fields serve at certain points, ramps at others and barges or floats at others. The type selected depends, of course, upon terrain or water conditions, location, and types of planes used. Often the situation is complicated by political by-play.

At St. Johns, Antigua, the prevailing wind, often blowing 25 m.p.h. and running counter to the fast tide, giving a short, choppy sea, makes barge fuelling difficult, so Pan American built a ramp on the western side of the mouth of the harbor. A similar ramp is used at Port Castries, St. Lucia, and there is another at Cocorite, twenty minutes' drive by auto north of Port-au-Spain, where gassing is done for this stop.

Georgetown, British Guiana, permits only a barge as a base. The Demerara River, with a current of 17 knots and a prevailing wind of as much as 30 knots upstream, with waves which reach five feet in height, makes a ramp highly desirable. Pan American has a purchase option on twelve acres of land on the south bank of the river, but because of a British concession to a British firm it cannot make use of the land for the ramp as yet. The gasoline on the barge is delivered in drums and served from them.

Regulations a hardship

Governmental regulations here produce a hardship which is interesting. Gasoline is shipped in and received at the government magazine and there held under bond until delivery. A customs official must be present both at the withdrawal time and at the refuelling, as sealed drums cannot be opened until previously opened drums are emptied. Aviation gasoline is admitted tax free, but other gasoline must pay import duty, hence the supervision. Procedure to eliminate this supervision by substituting other assurances of non-division of the aviation gasoline is being sought, as refuelling might be held up if the customs men were all busy with incoming steamship duties. Pan American uses a ramp at Paramaribo. At Miami it uses field storage tanks, as at Havana and Camaguay. At Santiago, at present not a port of call, gas was stored in barrels and served from them to planes, permanent tanks not being erected because of dissatisfaction with the airport as a permanent base. A field tank is used at Port-au-Prince, at Santo Domingo, and at San Juan.

Cozumel Island offers one of the most interesting stops on the Pan American run. The planes land on a lake seven miles from the town of San Miguel. A strip of beach between the lake and the sea has been cleared and the barrels of gasoline stand there until used. They are brought by schooner to San Miguel, transferred to barges and lightered to the lake shore.

Belize, British Honduras, is served by a ramp up which the amphibions climb and where they are fuelled from barrels. Eight miles west of the city and up the river, Pan American is completing a splendid airport where bulk storage equipment will be installed. At Tela, Honduras, a field adjoining the race track grandstand is used.

Managua, Nicaragua; Puntarenas, Costa Rica; David, Panama; and Panama City, all are barrel-served. At Cristobal a gas truck is used. At Cartagena, Colombia, barrels are used. So at Barranquilla, Colombia, and at Curacao, Dutch West Indies, and at Maracaibo and Maracay in Venezuela. Tank installations are now being completed at some of these fields.

An idea of some of the difficulties that may arise in getting gas to a field is gained from Puntarenas. The field is seven miles from the town. Two miles are along a trail. An ox cart brings the drums over this stretch, after they have been brought part way by barge on the flood tide from the town. The gasoline used is shipped to Puntarenas from Talara, Peru.

In spite of the difficulties involved in getting gasoline to isolated points the American companies operating in the tropics have had excellent co-operation from the leading oil companies, and service has been almost universally good. One American company which has developed a special aviation gasoline for one of the transport lines in the tropics has its source of production so far from the tropics that the delivered gasoline would be too expensive, and hence it is not being used. The problems which have been peculiar to the tropics are fast disappearing with the improvement in general transport and economic conditions in Latin America.

Passengers purchasing tickets at the air passenger bureau of the Air Traffic Association in the Palmer House arcade, Chicago

Selling air transport

As told by an airline traffic manager to

James P. Wines

THE era of low airline tariff—if practically giving away transportation may be called charging a tariff—has been concluded. Supposedly we have learned many things concerning fare, fear, volume of traffic and the attitude of the public toward the airplane as a means of transportation. At least the principal passenger carriers accumulated more schedules, figures, passengers, waiting lists, advice and deficits than they knew how to handle.

The peculiar thing is that the majority of the lines were losing money before the rate reductions went into effect. While we were carrying the passenger from his hotel in one city to his hotel in another, while we were giving away box lunches, ear plugs, magazines, chewing gum, cigarettes, the best transportation in the world and our stockholders' money, all for rail-plus-Pullman rates or less, we continued to operate at a loss. And now that the fares have been boosted again, most of us are still in the red.

An analysis of the traffic of any passenger line is interesting. One line, with which the writer is familiar, operates an air-rail service between two of the largest cities in the country. It is an excellent set-up, offering a real service to the business man. The passenger leaves by plane in the late afternoon and arrives at his destination by rail early the following morning. During the bargain rate period, he could actually save $4.00 by making use of the airline and its rail connection instead of taking the train for the entire trip. The result was that as many as 30 persons were turned away daily, simply because no accommodations could be provided for them by the airline operator.

Economic necessity demands that airline operators offer more frequent schedules, and use the most up-to-date flying equipment available. These make a wider use of the lines by the public essential, and put the responsibility of selling the public on the traffic departments. It is pointed out that business is being lost today through unwise efforts to economize.

The surprising thing is that traffic over the route was chiefly local. Two sections were flown daily each way during the period that the rate reductions were in effect. Of the 24 seats available to through passengers an average of only five were taken each day by persons who intended to make use of the rail connection, in spite of the saving in time and fare that was offered. The railways between the two cities operate several trains and carry approximately 1,500 through passengers daily. In other words, the airline carried only one-third of 1 per cent of all the through passengers—hardly enough to lead one to believe that the airlines are as yet even offering a supplementary service to the railroads.

Let us attempt to determine some of the reasons why it is that the airlines

are carrying such a small percentage of the passengers and why the lines are not operating at a profit. One of the major reasons, no doubt, is the infrequency of airline schedules. The air passenger does not fly simply for the thrill of flying; there is no thrill to speak of in riding in a tri-engined transport or any other cabin plane. He flies because he wants to save time. If a person were to purchase a combined air-rail ticket on the line that was mentioned above and then were to miss the plane, he would lose a great deal more time than the amount he hoped to gain. By the time the plane leaves, all of the fast trains between the two cities have left. He would be forced to take a slower train or remain in the city overnight.

A very interesting experiment is now being conducted by an airline that has been operating for several months in the East. The operator, the New York, Philadelphia and Washington Airway Corporation, is running planes in both directions over its line every hour on the hour between 8 a.m. and 6 p.m. The success of this new venture proves that frequency in schedules is something that the airlines must provide if they ever hope to entice more than a small fraction of the traveling public into their planes. At present, catching a plane even for a short journey is much like catching a steamer for a trip abroad, but it should be more like boarding a bus. If the traveler misses one, he knows that another will be along shortly.

Unfavorable weather is something that we have not yet been able to overcome entirely, and, for the time being at least, we must be content to use the system of notifying passengers in advance when weather conditions make flying unsafe, so that they can resort to other means of transportation which are not affected to such a great extent by meteorological conditions. Multiple schedules at frequent hours during the day, however, will do much to demonstrate the dependability of air travel and to popularize it with the public, even though weather conditions necessitate cancelling an occasional trip.

Serving refreshments to passengers aboard a Universal (American Airways) plane

Better service, more business

The operating departments will say that schedules cannot be increased until a greater volume of traffic is secured, and that the types of aircraft in use are too expensive to operate. To obtain more business, we must render much better service, eliminating the frequent complaint that service is not available when it is needed. Recent experience seems to indicate that the solution of this difficulty lies in the use of units of relatively lower passenger capacity than some of those in present use. In fact, it may be said that the manufacturers have not as yet produced any equipment which will give an operations department a reasonable opportunity to show any sort of profit. Greater volume of business will allow more money for development work, however, and the engineers have always produced when the pressure was sufficient great. The pressure can be increased by flying more passengers on more schedules, and using more planes. More plane movements mean less cost per mile, and more planes mean lowered cost per plane. Equipment that can be operated profitably when reasonable tariff is charged, and more frequent schedules are two highly important factors.

There is another important step which must be taken before the airlines can be expected to start paying dividends to the stockholders. We must sell air transportation to the public. We are in a business with a considerable capital outlay and with a very definite product to sell, yet there is apparently no airline that is placing in effect a carefully designed sales policy backed by a vigous sales organization. The traffic departments of the airlines are, of course, the sales organizations, but they are not

Passengers waiting for airport bus at the United Aircraft and Transport passenger station in the Chicago business district. Boeing, N.A.T., and Stout all use this office

organized as they should be. There are many men in them who are not well placed. Surly individuals are often given the responsibility of handling passengers who must be treated with every courtesy if they are to be retained as permanent patrons of the line. Men with 15 minutes' selling experience are asked to call upon $25,000-a-year executives and convince them that the airlines are the only way to travel. The chief virtue of these men is that they are cheap. It is well never to lose sight of the fact that the services of a real salesman—the man who can successfully sell air transportation—cannot be obtained for $125 a month.

Considerable leniency has been shown by the airline executives in dealing with expenditures of the operating departments in development and experimental work, but a traffic department is not considered successful unless its cost of operation is far below that allowed normally by a manufacturer for selling expense in marketing his product. Air transportation must be sold. The tendency to depend upon the Post Office Department and all the hoped-for development in equipment, with resultant economies in operation, will not solve our problems. Tremendous pressure generated by a large volume of traffic is the real key to the situation, but there will be no volume if it is not developed by sales effort.

Developing express

There has been much talk concerning the development of air express and freight business, but so far nothing much has been done about it. Each of the larger lines could well afford to charge some member of their organization with the setting up of an express service in connection with the passenger service. The theory of obtaining revenue from carrying express packages is well advanced, but theory will not pay our bills.

At the present time, the opinion of those in the industry concerning the advisability of national and even local advertising seems to differ greatly. Many officials who have had considerable experience in other lines of business feel that a concerted national advertising campaign on the part of the entire aviation industry would bring results that otherwise would necessitate years of waiting. If advertising will help solve the various problems, it certainly should be worth the cost.

Cash reserves are now guarded like the national treasury and added expenditures, particularly by the traffic departments, are considered capital offenses. Yet the passenger planes are not carrying capacity loads and will not carry them until some money is spent in the development of the business. Our stake is large enough to warrant the same type of sales effort and expenditures that are allowed any manufactured product of merit. Business can be had but it must be brought in by salesmen. There has never been devised a more effective method than an engraved card, a pleasant smile, a logical story and good old American shoe leather.

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Foresight in airport design

By B. Russell Shaw
Airport Engineer

THE old statement, often repeated, that acreage does not make an airport, was never truer than at the present time, and it is becoming even more obvious with the increase in aerial operations throughout the country. It is equally important that airports should be located, designed, and constructed with an intimate knowledge of the requirements necessary, and above all with a certan knowledge of future demands that can only be obtained through close and active association with the aeronautical industry.

Designing an airplane requires, in addition to a complete understanding of flying, a most thorough and complete knowledge of the science of aerodynamics. It has not been many years since airplanes were, for the most part, constructed by rule-of-thumb methods. At that time no mechanic hesitated to build his own airplane after inspecting those used by the barnstorming pilots of the neighborhood. Many of these hayloft contraptions flew fairly successfully and it was not until they were put to a crucial test that these aspiring aviators learned the error of their ways and calculations.

History repeats, and we find in many localities the evidence of inexperience in the designing and constructing, lighting, and management of airports. Here again, some of the more ambitious city officials have employed inexperienced engineers or have depended entirely upon local talent for design. In a few instances, these ports have everything that could be asked, but in the majority of cases the errors are just now bearing fruit in dissatisfied operators, improper surfacing, poorly laid out fields, and a disastrous lack of provision for future expansion.

We who have had the privilege and opportunity of growing up with the aviation industry have one prime interest—to see the industry as a whole prosper. Perhaps our motives are selfish to the extent at least that if the industry prospers, if it carries on in a firm and business-like way, we too will be able to advance in proportion. It is with this thought that the pioneers in the industry and in airport engineering have in mind the developing of airports that will be a credit to the industry and that will assist in showing a profit wherever a profit is possible. Incidentally, in this connection, profits can be shown. This has been proven.

Not a circus

An airport is not a circus ground, and the sooner we discourage the circus stunts the more quickly will the public be sold upon the safety and reliability of the airplane. In many instances, ambitious aviation enthusiasts have endeavored to conduct their airports on a Roman-holiday basis, to bring the public to the field to sell them on aviation by having pilots show how dangerous flying can be, and still land without cracking up. How many automobiles would be sold if the salesmen concentrated on talking about the high speed of the car, the way in which you can avoid hitting telephone poles with a twist of the wheel at the last minute, the sureness of operation of the brakes in stopping at a crossing in case you find you cannot beat the train across? In aviation, we must stop trying to beat the train to the crossing. By providing the public with airports that convey subconsciously to them that aviation is a firm, established means of transportation, that its place in transport is as definite as that of the train or automobile, by sheer smoothness of operation and by steady, sane flying, we must instill a desire to become a patron and even to own a plane.

The airport engineer can do much in this field. In the first place, by proper engineering, he can prevent wasteful expenditure. He can provide airports that will be a credit to the industry and a lasting pride to the municipality. He can include not only facilities for air transportation, but also for the pleasant handling of the public. The clean, business-like atmosphere, found on some of our leading airports, is sadly neglected and lacking on many that are pointed to with false pride.

A pilot's plea for better visibility

Cockpits and Crashes

By
Grissom E. Haynes
Test Pilot

CLARENCE CHAMBERLIN was once quoted as saying, "When I can't see I don't fly," in which sentiments the writer heartily concurs, but that is not the whole story. When a pilot can't see, he won't take off, but if during the course of flight, he runs first into low ceiling, then haze or light fog, and, after coming down to 500 or 800 ft. runs into rain or snow of sufficient intensity to blot out visibility through an already oily windshield of the fixed type so common today, then it might be better if he could not see at all, than to have the semi-visibility of the usual sliding glass window on the side of the cockpit. If he were totally "blind" he could at least level off and "pancake" or glide into the ground at minimum speed, if necessary, with the probability of walking away from the wreck. In the second case he stands a good chance of flying into a high stack, a radio mast, a hill, or a tree, in the 90 deg. to 100 deg. blind angle which the semi-opaque glass ahead of him provides.

Blind flying

There is, of course, much talk of blind flying. A certain amount of the blind flying that is talked about is actually done, but it consists, more often than not, in pulling up through a low overcast ceiling of several hundred feet with the knowledge that the destination is, and will probably remain, relatively clear. This, with suitable instruments and radio, is relatively safe and often necessary in the regular transportation of passengers and mail, and will undoubtedly become an accepted practice. Any other form of blind flying at present, however, is usually bad judgment arising from accident or foolhardiness, and equally reprehensible in either case. If more experienced pilots would admit what they know to be true in this regard, aviation underwriters and the public would be less skeptical on the subject of scheduled flying.

Having disposed of the subject of blind flying by the usual pilot's method of flat assertion, consider what, for lack of a better name, may be called semi-blind flying, a problem that arrived with the cabin plane with enclosed cockpit, and which probably causes as many accidents as all other factors combined. It is unnecessary to compile statistics, or to cite specific cases. The following is familiar enough:

"The plane was seen to be circling low as though looking for a landing place over..... about 5:30 p.m. It was just at dusk and a light rain was falling while the haze restricted the watcher's visibility. Suddenly the plane was seen to bank sharply and go into a spin, striking the hillside [an electric tower, or whatever seems handy] and immediately bursting into flames. When the would-be rescuers arrived there was nothing left, but a charred...."

But why go on? Everyone knows the story from endless repetition. The newspapers probably never break up the slugs, at any rate they should not for it is, like the patent medicine advertisements, a frequent repeater. Another crash is charged up to a careless pilot or to bad flying weather. In one respect, the pilot probably was careless, as he had no business flying low considering the visibility limitations of his cabin plane (which almost invariably figures in these crashes), but the designer must share the responsibility with him.

A case in point

From the position of an observer on the ground, shift to the position of the pilot and passengers. Assume a pilot flying from Indianapolis to St. Louis in a six-place cabin plane with an engine in proper condition and of proven reliability. There are four comfortable seats with sliding glass windows for the passengers, and two side-by-side pilot's seats in front, with controls and a sliding glass window on each side for pilot and co-pilot. To protect these delicate young persons from even willingly exposing themselves to the fury of the elements, the kindly designer has placed a large area of glass in front of them shaped this way or that, according to his individual ideas, to shed rain, snow, sleet, or ice, and to prevent reflections and glare. To facilitate the wearing of flannels and a straw hat in January (on the chance that some pilot is flying hurriedly from Chicago to Miami for an informal dinner dance,) and to baffle the deadly streptococci that lurks in drafts, it is, however, fixed and immovable. The weather reports say: St. Louis solid overcast, 1500 ft. ceiling, visibility 2 mi., wind 6 mi. SW. That seems fair enough, so the plane takes off, and, for an hour and a quarter, flies along at 1500 ft., airspeed 115

and ground speed 105 and all is well.

About this time wispy clouds appear almost at the level of the plane and the sky becomes dark. The grey clouds persist in getting annoyingly lower, while shadow and haze cuts the visibility to one or two miles. There is not much chance to do any checking with the map, so they swing a little south to pick up the Pennsylvania Railroad with its station markings. By this time the altimeter shows 1000 ft. above the ground, and the pilot begins to see the grey wisps of clouds twice — once through the front glass as they approach, and again reflected in it as the plane passes under them. Their trajectories and movements, illusions and shapes as reflections are truly amazing. (On such a day, I have jerked sharply at the stick to dodge Pikes Peak—carelessly misplaced in Northern Indiana—and then grinned mirthlessly only to realize that it was but a cloud reflection in the windshield glass.)

Rain and the windshield

The double tracks of the railroad are in their accustomed place, however, and a check on a station roof with the map, shows the position to be 40 minutes from the "Father of Waters," so the navigation problem appears to be solved. So far all is well and they push on towards a grey western horizon, which five minutes later is revealed as a light misty rain. The drops collect on the oil spattered windshield, with the result that the front glass is covered with a wavy film of water, through which wierd shapes and outlines are to be seen, none of which should appear in country that is almost as level as a table. The pilot, however, drops down to what he estimates is 500 ft. above the tracks, and by opening the side window is able to follow the railroad. That 500 ft. may be either 300 or 700 ft. according to how the pilot feels, for the ordinary altimeter is of little use for making such delicate measurements under such conditions. They progress, however, without further incident, until the increasing violence of the rain becomes quite uncomfortable to the exposed head of the pilot, and at the same time reduces his vision. It is no longer possible to see straight ahead, but out the side window, the visibility is three quarters of a mile and the pilot finds himself tending to fly with the left wing down and the right rudder applied to hold the plane in a position where he can see a little further ahead.

In the adventure stories (both printed and verbal) he would pull up several thousand feet into the clouds and after a predetermined time, glide gently down, carefully watching his altimeter, and banking to avoid the grain elevator back of Hangars Five and Six, make a three point landing on Lambert Field! Being an average pilot, however, he pushes on, dropping lower to keep the railroad in sight, until the idea of landing strikes him. A glance at the rain soaked meadows and cultivated fields below convinces him that the idea is not so good, so he slips along the Pennsylvania at about 300 ft. until he reaches the outskirts of East St. Louis. This brings a real problem, as smoke stacks and high-tension lines, buildings, and switching towers begin to appear on all sides apparently in close proximity to the wing tips and the landing gear and to make matters worse, the southwest wind brings the smoke from Missouri's St. Louis over the river to merge with the Illinois product. About this time a steel smoke stack looms up ahead and he pulls off in a sharp left turn, to miss it. Since, for practical purposes, he can see nothing dead ahead or to the right, this smacks of that vastly superior part of valor, termed discretion. If he does not hit the guy wires supporting the smoke stack, or pull up too far and stall, or encounter some other mishap, he levels out on general south course toward unfamiliar country with that full feeling of uncertainty, which such a situation imparts. Fuel is getting low so he makes another 90-deg. left turn and flies away from the murky district, while he ponders on what to do. The most obvious answer is to try to get through to the north of the urban district, and thence up the west side of St. Louis, where he is sure he will find reasonable visibility. Skirting the east side of the down-town district, and making frequent left spiral turns to check up on his visibility, he flies north, and if some high obstruction does not reach up and bite him while he is trying to get the cold rain drops or hot oil out of his eye, or if he does not hook a wing in some high tension system, he will probably make it. If he doesn't, the city editors will reach out for the old reliable slug —"The plane was seen to be circling low as though, etc."

Forward visibility

The preceding is a fair sample of conditions (allowing for a few variations) causing most of the weather crashes of today. Of course, it is sometimes sleet, snow, or darkness as well as rain or light fog and low ceiling, but the thing boils down to lack of forward visibility. The chief and most unnecessary offenses against common sense are glass-enclosed pilots' cockpits not capable of being opened to their fullest extent. Pilots should not fly low in rain, heavy haze, sleet, or at night. This may be true, but they will fly at altitudes around 500 ft. in spite of everything, and do it successfully 99 44/100 per cent of the time. Except when crossing closely settled areas, they are probably justified by the dependability of modern aircraft and engines but, if they do it in closed cockpits, it will eventually lead them into difficulty through lack of forward visibility.

The open cockpit, located in the aft section of the fuselage, is hardly an improvement. The modern cabin monoplane, which is apparently the most efficient and practicable commercial plane, offers unsatisfactory pilot visibility even when the cockpit is shifted to the rear on account of its wide fuselage and engine, and the blanketing of vision directly ahead by the wing. A number of pilots consider the open-cockpit biplane and sesquiplane with cockpit well back of the wings, as the safest type for bad weather and night flying, and point to the popularity of this type on air mail lines as proof. Although it is a frequent saying, that "pilots know what they want", perhaps a better way of saying the same thing is "pilots want what they know". They trained on such planes, and the majority of their flying experience has been on such types, which accounts, in many cases, for their opinions. If all the road scrapers, traction engines, trees, telephone poles, planes, and other obstructions which have been hit by pilots in this type of plane were laid end to end East of Nantucket Light, it would be a good idea. It might keep many of the coming generation of pilots from hitting them, as they undoubtedly will, if they continue to fly planes with a blind area in front large enough to hide a hangar.

Suggestions

Problems of visibility are serious in practically all existing types. From the point of view of the pilot, however, there are a number of suggestions which might be made for the future guidance of designers. In the first place, cockpits should be open, or capable of being readily opened to their fullest extent at the first sign of nightfall or bad weather. Secondly, they should be located so the pilot's head is a few inches forward of, and near the level of the top wing. He should be able to see directly down and forward over the engine to a point not more than 40 to 50 ft. ahead of the wheels, when the plane is on the ground in landing position. Both wing tips (or a few feet ahead of them) and everything in the forward radius between should be fully visible. The seat should be of the movable type (up and down) in order that it may be raised a few inches on a landing or take off to see over the engine, or lowered while cruising at a safe altitude. This will enable the pilot to get entirely out of the airstream behind the windshield, take off his goggles and relax until landing or dirty weather forces him to come up. If this could be done on modern transport planes, the editors might have to throw away the old reliable slug, for if a pilot can see ahead in a sufficiently wide range, he can usually maneuver to avoid hitting any obstructions.

Flying Equipment

APPROVED TYPE CERTIFICATES

DURING the period March 14 to April 11 the Aeronautics Branch of the Department of Commerce issued the following Group I approved type certificates: 405 Buhl, The Flying Bull Pup LA-1 (Szekely SR-3 Model O, 45 hp.); 406 Curtiss-Wright, Travel Air 12 K (Kinner B-5, 125 hp.); 407 Curtiss-Wright, Travel Air 12W (Warner Scarab, 110 hp.); 408 Kreider-Reisner, KR-C7 (Michigan Aero Rover, 75 hp.); 409 Ford 5-AT-D (three Wasp SC, 450 hp.); 410 Pitcairn Autogiro PCA-2 (Wright R975, 300 hp.); 411 Curtiss-Wright, Travel Air 16-K (Kinner B-5, 125 hp.); 412 Waco QDC (Continental A-70, 165 hp.); 413 Sioux, Coupe 90-A (Brownback Tiger C-400, 90 hp.); 414 Sioux, Coupe 90-B (Warner Scarab Jr., 90 hp.); 415 Fairchild, Model 135 (Fairchild 6-390, 130 hp.); 416 Waco, QCF (Continental A-70, 165 hp.).

THE MATTLEY "FLIVERPLANE"

BUILT by the Mattley Airplane and Motor Company, Inc., the Mattley "Fliverplane" is of interest in connection with the present trend toward small low priced aircraft. Powered with a Continental A-40 engine the machine is a semi-cabin type high-wing monoplane accommodating one person. It weighs 875 lb. fully loaded.

Span	35 ft.
Chord	5 ft. 6 in.
Wing section	Gottingen 297
Length overall	20 ft. 8 in.
Height overall	5 ft. 8 in.
Wing area, total	192 sq.ft.
Landing gear tread	8 ft.
Weight, empty	550 lb.
Useful load	325 lb.
Weight fully loaded	875 lb.

TWO NEW EMSCO MODELS

TWO approved type certificates have recently been issued to the Emsco Aircraft Corporation, Downey, Cal., on planes which have been under development for more than two years. The Emsco model B-3-A nine-place, high-wing cabin monoplane, powered with a 420-hp. P & W "Wasp," has been issued A.T.C. No. 400. The Emsco model B-7, mid-wing monoplane trainer has been issued A.T.C. No. 403. The B-7 is powered with a 165-hp. Continental A-70, a 160-hp. Menasco A-6, or a 170 hp. Curtiss Challenger engine. Both models are now on production.

	B-3-A	B-7
Span	56 ft.	36 ft.
Chord	9 ft. 1 in.	6 ft.
Length overall	40 ft. 10 in.	22 ft. 11 in.
Weight, empty	4,000 lb.	1,492 lb.
Useful load	2,600 lb.	607 lb.
Pay load	1,625 lb.	200 lb.
Gross weight	6,600 lb.	2,100 lb.

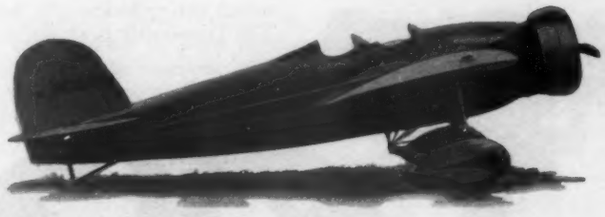
CORNELIUS MONOPLANE

FLIGHT tests were recently made at United Airport, Los Angeles, of the Cornelius "Fre-Wing" monoplane, a new type of craft in which the wing panels are pivoted about the lateral axis of the plane, ailerons and elevators are eliminated, and auxiliary surfaces known as stabilators are used to control angle of attack of the wings. In other respects the plane is of conventional appearance, a high-wing, strut-braced, two-place open monoplane powered with a Menasco B-4, 95 hp. engine. The structure follows conventional practice.

The wings are mounted to a braced center section. Two struts from each lower longeron brace each wing panel, converging at a fitting on the axis of rotation. The position of the wing panels with relation to each other is controlled through a vertical strut at the inner end of each rear spar extending downward to a connection with the stick control in the cockpit. The stabilators control the angle of attack independently of the lateral control and may be adjusted from the cockpit. The horizontal stabilizer is pivoted laterally about its fore and aft point of aerodynamic balance and moves in conjunction with the angle of attack of the wing panels.

In a turn the action of the stabilators is said to bank the plane automatically, causing each wing to assume its normal relative angle of attack.

Longitudinal control is accomplished in conventional fashion through a simple fore and aft movement of the control stick, which forces the entire stabilizer to rotate together with a slight move



Above, right: Mattley "Fliverplane" Above: The Emsco B-3-A, nine-place monoplane. Below: the B-7 trainer

ment of the wings. Thus, as the angle of attack of the stabilizer is increased to cause a dive, the angle of attack of the wings is decreased, and conversely as the angle of attack of the stabilizer is decreased for a climb the angle of attack of the wings is increased.

Lateral control is accomplished by the purely conventional movement of the stick from side to side, but instead of operating ailerons as in an ordinary airplane this movement of the stick causes the wings to be displaced with relation to each other. Manufacturer's specifications follow:

Span	30 ft. 6 in.
Length overall	20 ft. 6 in.
Height (flying position)	7 ft. 10 in.
Wing area	146 sq.ft.
Weight, empty	1,010 lb.
Weight, loaded	1,490 lb.
Wing loading	10.2 lb. per sq.ft.
Power loading	15.7 lb. per hp.

The Cornelius Fre-Wing monoplane

THREE JACOBS AIRCRAFT ENGINES

THREE new air-cooled engines of 25, 60, and 150 hp., designed for use in power gliders, light airplanes, and heavier two-or three-place machines respectively, have recently been put on the market by the Jacobs Aircraft Engine Company of Camden, N. J. In all three a simplicity in design has been achieved, which makes for clean installation, accessibility, and ease of adjustments and repair. The general servicing policy of the Jacobs company is to minimize repairs or adjustments in the field by replacing units which need attention with new ones, and returning the former to the factory for repair.

An interesting experiment is being tried in the case of the 150-hp. engine in that it is being marketed as a complete power plant unit, with N.A.C.A. cowling, built-in exhaust manifold, and the whole permanently mounted to a plywood mounting bulkhead designed to be bolted directly to a fuselage. The airplane designer has only to provide three points of attachment for the bulkhead and to connect up his cowling with that furnished with the motor. The exhaust manifold and cowling are arranged so that the entire assembly can be easily removed from the engine when necessary. Minor adjustments, such as setting valve clearance, lubricating locker arms, etc. can be made through small openings provided for the purpose without disturbing the cowling.

The L.A.-1 is a seven cylinder radial engine of 150 hp. The cylinders are provided with die cast aluminum heads bolted on. Each cylinder is equipped with two valves operated by push rods from the crank case through open overhead rocker arms of very simple construction. Cam and tappets are of the roller type, each equipped with a generous roller operating on a hardened steel bushing, and valve adjustment is accomplished by means of set screws in the ends of the rocker arms. The crank case is of forged aluminum alloy to which the cylinders are bolted by studs. The crankshaft is of the one piece type, counter-balanced, and the connecting rod assembly is of the split type. Both units are machined all over.

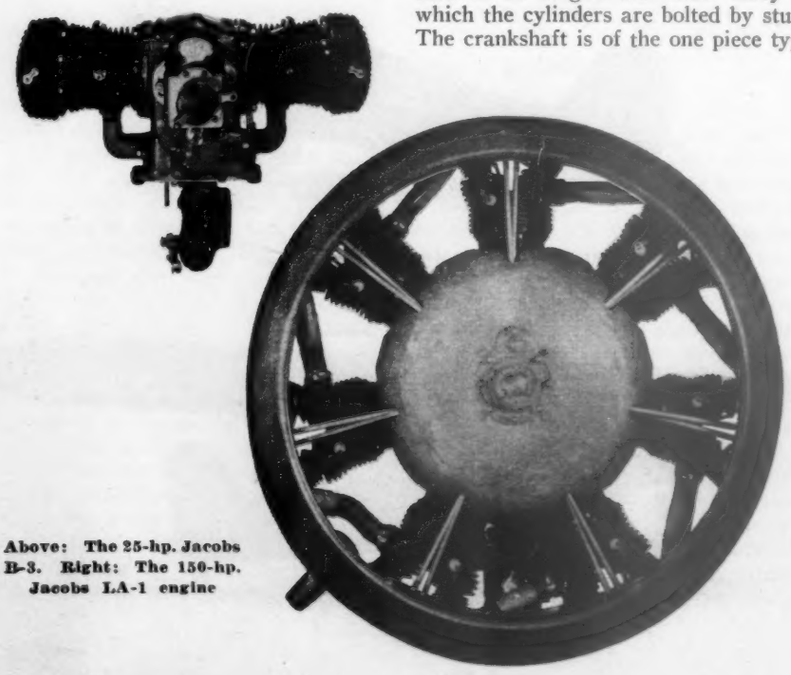
Ignition is provided through two spark plugs per cylinder and a pair of Scintilla single-spark magnetos mounted on the rear end of the crankcase turning at $\frac{7}{8}$ crankshaft speed. Carburation is by a single Stromberg carburetor supplied with low pressure air from a built-in rotary blower. Further specifications of this engine are given below.

The three-cylinder, 60-hp. engine is designed along lines somewhat similar to the 150-hp. type. The crankcase is, of course, much simplified and each cylinder is fastened to it each by a pair of long through bolts, rather than studs as in the larger model. To remove a cylinder from this engine it is only necessary to loosen two nuts at the head end, swing the bolts out of the way, and lift off the entire cylinder assembly. The two valves in each cylinder are actuated by push rods and open rocker arms. Dual ignition is supplied from a pair of Scintilla magnetos, and fuel is supplied through a single Stromberg carburetor. No cowling is provided with this unit, but short individual exhaust stacks are furnished.

The 25-hp. "Midget" differs radically from the two larger engines in that it is of the two-stroke-cycle type. Cast iron cylinders with bolted on aluminum alloy heads are horizontally mounted on opposite sides of a box type crankcase. The single magneto is supported on the rear end of the case and the carburetor is attached to a flange below the mounting pads. Connecting rods and dual forgings and the crankshaft is fully machined and supported in roller bearings. Thrust is taken on two suitably designed ball bearings.

The general characteristics of the three engines are as follows:

	A-1	B-2	B-3
Cylinders	7	3	2
Horsepower	150	60	25
Rated r.p.m.	2,000	2,000	2,500
Displacement	528	190.8	....
Bore	4.5	4.13	3.75
Stroke	4.75	4.75	3.25
Compression ratio	4.8	4.8	....
Type of piston	Trunk	Trunk	Trunk
Mounting circle	14½	13½	....
Weight, dry	393	170	72



Above: The 25-hp. Jacobs B-3. Right: The 150-hp. Jacobs LA-1 engine

Aircraft at Work

Hop Business From Conventions

IT is regrettable but none the less undebatable that the miscellaneous "joy hop" business has largely disappeared except in those locations where unusual scenic effects continue to attract the air rider. The days when every week-end meant rushing business at every airport, taking care of practically unsolicited business, are now definitely of the past.

One method used by the Curtiss Flying Service in re-stimulating a certain amount of this activity has been the practice of studying carefully the programs for conventions in the cities at which their stations are located. Schedules of such conventions are usually obtainable from local chambers of commerce, national chambers of commerce, fraternal organizations, and boards of trade. Once the convention is spotted and the names of those in charge ascertained, the local sales unit makes its first approach by letter, or by personal solicitation, depending on the location of the headquarters of the convening body. In general, the approach letter simply suggests a visit to the airport and an invitation to call on the Curtiss hangar, to consider themselves as Curtiss guests and to be shown around by Curtiss employees. It is also suggested that if any sizable group cares to fly a low rate can be quoted. Neighborhood sight-seeing trips are described or suggested. The Boston base, for example, has made a practice of suggesting a flight to Concord and a tour of the harbor. They also make the offer of one of their personnel to address the convention on recent developments in aeronautics, which is occasionally accepted, and has generally paved the way to later business.

A Whirlwind-powered plane of the Hawke Crop Dusting Company

The actual response on a basis of percentage of convention attendants visiting the airport to those invited is not great but it is certainly worth while. Almost without fail, once a group visits the airport, a large portion of it does make some kind of flight. Very frequently members of the party who have not intended to fly are carried along by their companions who are less timid, or who have had previous flight experience. As an example of the actual operation of the system, on New Year's day, the sixteenth annual convention of the Phi Alpha fraternity, which was being held in Boston, visited the airport. At first only 20 signified their intention of flying, but before the group left the airport over 70 of them had been taken up.

A Flying Basketball Team

A NOVEL use of flying equipment which has resulted in some legitimate publicity for the resident school operated by the Vermont Airways at the Barre-Montpelier Airport, has been the organization of a basketball team among its students and pilots. During the winter instruction has been given in planes mounted on skiis, and the team has made it a practice to use one of the school machines in meeting their out-of-town schedules.

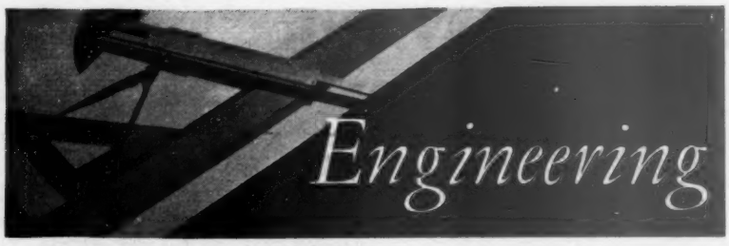
The Barre-Montpelier Airport team and its plane

California Takes Up Crop Dusting

NOT since the days when the Huff Daland Duster was especially developed for the cotton growers in the southern states has much engineering activity gone into special airplanes for dusting purposes, although in numerous cases standard models have been modified to suit the special requirements of this service. This period of inactivity is now broken by a new plane which has recently been completed at the plant of the Hawke Crop Dusting Company in Modesto, Cal. One was completed and tested during the winter, and two more were scheduled for completion on March 15.

Designed by H. S. Tharp, chief engineer, and O. W. Pilgrim, chief pilot of the dusting company, the plane is powered with J-5 Whirlwind engine, and carries in addition to the pilot, approximately 1,000 lb. of dusting material. It is probably the first use of an externally braced cabin monoplane for this type of service. The hopper has been built integrally with the fuselage and special care has been taken to insure good visibility and protection for the pilot from the dusting clouds issuing from the hopper. Stress has also been laid on quick take-off, maneuverability. and reasonable landing speed.

E. R. Hawke, local business man, is backing not only the manufacturing company but also an operating company known as the Hawke Crop Dusting Company which will carry on crop dusting activities in California.



THE PROBLEM OF ENGINE VIBRATION AND PASSENGER COMFORT

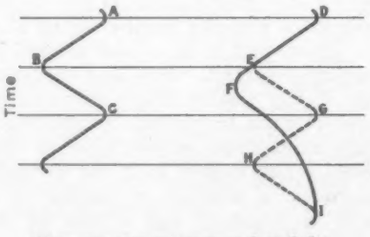
THE problem of producing an aircraft engine as free from vibration as is the present day automobile engine is very difficult, as the designer cannot use mass to absorb vibration by static inertia. From the standpoint of durability the thermal, lubricating, and metallurgical problems involved are much more important than the reduction of external vibration, and the burden falls upon the aircraft designer to build a structure around the engine which will absorb the vibration without causing discomfort to pilot and passengers. The original design of the engine of course has a decided influence on its vibratory characteristics. Certain types are inherently more or less free from vibration, but others must be mechanically balanced. Cylinder location, fuel distribution, and the inertia of propellers or supercharger parts all have their effect, but even in the best modern designs, objectionable external vibration always exists, due to their low weight-power ratio.

Vibratory energy from the engine must be absorbed by the static inertia of the airplane. This may be accomplished by increasing either the weight or the rigidity of the structure,—but, as weight must be kept at a minimum, the greatest possible stiffness must be obtained by so distributing the material that the maximum moment of inertia will be obtained about the principal axes of vibratory movement. By suitably proportioning the structure, the lower vibrational frequencies are readily absorbed, but recourse must be had to cushioning pads built into the engine-mount to reduce the effect of higher frequencies. The function of such pads is to transform the high frequencies into those of a lower period which may then be absorbed by the structure. Where engine and framework are rigidly joined together the vibrations originating in the former are transmitted directly to the latter. Such forced vibrations in the structure are frequently in phase with those of the engine and the net result is a vibration of increased amplitude at the original frequency. If, on the other hand, the structure of the airplane is permitted to vibrate at its own natural frequencies without being forced into synchronism with the engine through a direct connection, the probabilities are that the natural frequencies of the two will be widely separated, and their mutual interference will result in some intermediate frequency of reduced amplitude. The first condition may be illustrated by the curve at the left in the accompanying figure, which represents a "Time-Movement" curve for an engine rigidly attached to the structure. The engine is normally at rest at *A*. A vibrational force within it acts against its static inertia, moving it to *B*, at which point the vibrational force is expended and is absorbed by the kinetic energy stored in the engine mass and by the deflexion of the supporting structure. Before another vibrational force is produced the deflected structure returns the engine to point *C*. If there is no energy lost through heat by internal friction in the deflected members, the entire amount of the vibrational force stored in the structure is returned as kinetic energy in the mass of the engine in the opposite direction.

The curve at the right represents the same engine with an efficient cushioning pad between it and the supporting structure. The deflection of the supports permits the movement from point *D* to point *E* and the deflection of the pad permits an additional movement to *F*. The energy stored in the deflected pads and structure is thus returned as kinetic energy in the engine, but, before the return is completed, a second vibrational force is exerted at *G* in a direction opposite to that of the moving engine. The result is a neutralization of forces, and the engine is returned along the dotted path to the point *I*. In this case the amplitude of the structure has not been changed but the period has been reduced one-half. In practice, however, the amplitude of the structure is actually reduced because some of the vibrational force energy is consumed in internal friction in the pad. It may be stated in general that the introduction of cushioning pads in engine mounts will materially reduce the period of vibration in the body structure, and will also reduce the amplitude in proportion to the internal friction developed in the pad.

Probably the best material for insulating engine mounts against vibration is rubber in some form. When using rubber, however, there is danger of having too much, rather than too little flexibility. This property of rubber is measured by means of a durometer, and when selecting pure rubber pads for use in engine mounts, a durometer reading of from 70 to 80 on the "A" scale should be specified. Where all rubber is used, the flexibility of the pad may be reduced by (1) increasing the unit compressive stress, (2) increasing the area under compression, (3) restricting the flow, or (4) reducing the depth of material, or thickness of the pad. Perhaps a better material than all rubber for this purpose is rubberized fabric in which layers of cotton fabric are alternated with layers of rubber. This type of pad has a large capacity for consuming energy due to greater internal friction, and has greater shock resistance with small deflection as the rubber is divided into thin layers and the flow is uniformly restricted.

It is a well known fact that rubber and rubber compounds tend to deteriorate when exposed to the atmosphere, especially to sunlight. In comparing two blocks of rubber of equal volume, the one which has the least exposed surface will have the longer life. Although the comparatively thin pads used under engine mount has relatively small surface exposed to the atmosphere, they are located where they can absorb oil readily and therefore must be watched carefully for signs of deterioration. Only oil resisting grades of rubber should be used.



Time-movement curves for (left) an engine directly connected to the fuselage, and (right) the same engine mounted on efficient insulating pads

In general, the amount of resistance to deformation of rubber under compression is governed by the following properties: (1) chemical composition; (2) curing process, or heat-treatment; (3) work done on the rubber, or the energy it absorbs; (4) volume of the block of rubber; (5) shape of the block, with and without load; and (6) the amount of internal friction transformed into heat.

In designing cushioning pads for engine mounts, there are a number of points which the author has found important. These points may be of interest to anyone contemplating the installation of rubber insulation in an airplane engine mount.

1. Select a material with highest possible hysteresis value.

2. The pad material should develop large internal friction under deflection, but the heat so developed must be dissipated to the structure at a sufficiently rapid rate to prevent deterioration of the pad.

3. The cushioning pad should permit just enough movement of the vibrating part so that the time required for the latter to complete one-half cycle of vibration with the pad is equal to from 60 to 70 per cent of the time required for a complete cycle without the pad.

4. The initial unit compressive stress in the pad is inversely proportional to the additional energy storing ability per unit load which the pad is supporting.

5. It is desirable to have the bolts which clamp the pad to the structure independent of the engine bolts.

6. The required tension on the pad bolts is a function of the amount of vibration in the engine. (Suitable instruments are being developed commercially for the measurement of vibration and the proper determination of bolt tension.)

7. Pads should be installed as far as possible from the axis of rotation of the engine.—Roscoe I. Markey.

THE TECHNIQUE OF SLIDE FASTENERS

THE use of slide fasteners, or "zippers," on external inspection panels in the fabric covering of airplanes of both military and commercial types has long been commonplace, their use in the linings or upholstery of cabin planes at points adjacent to vital points of control systems or of fittings is on the rapid increase. Some information on their technical details might not therefore be amiss at this time.

Slide fasteners are available in three basic sizes, the smaller size being used with $\frac{1}{16}$ in. and $\frac{5}{16}$ in. cotton tape and $\frac{1}{16}$ in. rayon tape, the medium with $\frac{3}{4}$ in. cotton tape or braid, and the largest with $\frac{7}{8}$ in. cotton tape or braid. The sliders and pulls can be obtained in a variety of designs and finishes, either in nickel-silver or "nu-gold." The attaching tape is available in many colors, matching any base fabric color or providing a pleasing contrast to it. The metal length specified should be the same as the opening to be closed.

In securing a satisfactory application, there are three points which must be observed, the terms used being explained in Fig. 1. The first point is that the tape ends at the top should be folded sideways at an angle, as shown at 1-1 in Fig. 2, and fastened securely without cutting them off. The second point is to stitch them no closer than $\frac{1}{16}$ in to the chain (see 2-2 in Fig. 2) with a double row of stitching recommended, the loose ends of the thread being trimmed off. If the raw edges of the material in which the opening is made are carefully kept away from the chain, the slider will always move up and down freely. The third point is to stitch the bottom of the fastener securely and immediately below the bottom stop as at 3-3 in Fig. 2. A minimum of two rows of stitches is recommended, with more preferable. The lack of proper reinforcement at this point would cause the slider to stick or the fastener to pull away. This is the simplest or visible means of attaching fasteners. It is also possible to install them with concealed single or double pleats.

Slide fasteners are easily applied and may be handled economically in large or small scale production. They can be applied with ordinary commercial sewing machines with the presser foot ground off on one side although special machines and attachments can be obtained in the open market which greatly reduce labor costs.

In using the slide fastener in external applications on military planes, the large fastener on $\frac{7}{8}$ in. olive drab tape is most common. The method of application is to take a 4-in. width of picoted airplane fabric and sew a fastener assembly down the center of it, without cutting the airplane fabric. This assembly is then sewed or glued on to the airplane fuselage in the desired position. After this is done, the metal part and the fabric of the fastener are covered by means of waxed paper as far out as the stitching. The dope is then applied to the fuselage and can be brought in over the stitching on the fastener fabric. After the dope has dried the strip of waxed paper is removed. The fastener is then pulled open and a pair of scissors or a knife used to cut the opening through the picoted airplane fabric strip.

In order to insure long life to the fabric of the fastener, beeswax can be rubbed into the fastener tape. The result is a very flexible and easy working fastener.

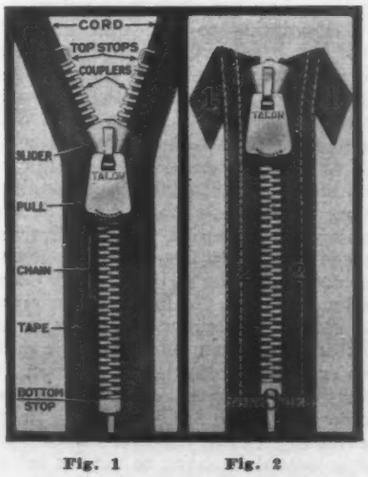


Fig. 1 Fig. 2

Technical Abstracts

THE N.A.C.A. ANNUAL REPORT

Sixteenth Annual Report of the N.A.C.A.

IT is always difficult to abstract an abstract, it is more difficult still to attempt to condense a long and complex report all of whose parts seem of equal value and are in themselves condensations of reports on a multitude of activities.

The sixteenth annual report of the N.A.C.A. differs little in form or general structure from the previous annual reports of that body, which have become familiar to the entire aeronautical industry. To one who is interested in segregating the products of the committee itself and of its laboratories over the past year, the task is increasingly difficult, because never before in its history has the N.A.C.A. exercised such a perfected control over practically all of the aeronautical research carried on throughout the country; never have its purely administrative functions been so emphasized. The research laboratories of every university in the country, that part of the Bureau of Standards assigned to aeronautical studies, the Forest Products Laboratory, Wright Field, the Navy Bureau have all been materially aided during the past year by the advice and direction of the national body in the choice and conduct of its researches.

Part I describes the organization of the committee, states its functions, lists its various members and its executive and sub-committees. It also describes in summarized form its headquarters and its own special research laboratory at Langley Field. Much of the energy and a large portion of the funds of the committee have been absorbed during the past few pears in the developing of its truly unparalleled plant. During the past year from a total appropriation of $1,488,000, $800,349 were spent for equipment. To its well-known variable

density and full size propeller research tunnels, and to its orthodox atmospheric tunnels, engine laboratories, and full flight testing equipment, are being added a new full size tunnel for the testing of complete airplanes and a seaplane channel 2,050 ft. long. Already one of the leading and most unique organizations of its sort in the world these last two items of equipment makes it potentially the greatest source of aeronautical technical research ever created.

Part II which deals with general activities, reports the study of aircraft accidents which has now been carried on for two years, describes the consideration given by the N.A.C.A. to a huge number of inventions which were referred to various government departments during the year, discusses the results of last year's visit of representatives of the industry and brings out the high degree of co-operation furnished the Air Corps of the Army, the Bureau of Aeronautics of the Navy, the State Department and the British Aeronatical Research Committee.

Part III, the reports of the various technical committees, is a rather exhaustive report on the subjects undergoing research in all parts of the country. Not only are the problems being attacked at the Langley Field laboratory discussed, but through the various sub-committees on aeronautical research in universities, on airships, on power plants, on materials and their various sub-committees, practically every laboratory in the country is brought into this report.

Each of the technical papers which have been published throughout the year are abstracted in Part IV.

The final part of the report, (V) summarizes (1) recent progress in aircraft development, (2) the research work which was carried on during the same period and (3) that which is planned for the next twelve months. In aerodynamics, spinning has been studied in a thorough way and will be further pursued in the new vertical wind tunnel designed especially for that purpose. Structural safety has been aided by pressure distribution tests and the continued use of the accelerometer. A great deal has been done already in the propeller tunnel on the general subject of reduction of drag and a great deal more is expected from the full size tunnel now under construction. Studies on stability, especially near the stalling speed, and its general relation to maneuverability are being pursued. Airfoil tests are being continued and are being co-ordinated through wind tunnel data, through investigations in the large tunnels. Ice formation, boundary layer control, propellers and airships are also on the list. A great deal has been done in the last twelve months on airplane structures. Many design details have been much better understood than formerly and our knowledge of materials of all kinds has been greatly increased. Importance of airships is by no means overlooked and the new ships building in Akron and the Graf Zeppelin have been noteworthy achievements. Of engines, the outstanding features are the further perfection of the radial aircooled engine and its cowling, the rapid development of the Diesel, and the beginning of a foundation for American engines of a 1,000 hp. or more per unit.

FLYING CONDITIONS PRECEDING CRASH

THE BEHAVIOR OF CONVENTIONAL AIRPLANES IN SITUATIONS THOUGHT TO LEAD TO MOST CRASHES, *by Fred. E. Weick; N.A.C.A. Technical Note No. 363.*

AFTER several years study of airplane accidents, the N.A.C.A. has concluded that little was technically known about the flying conditions preceding most of the crashes which achieve the distinction of an entry into the records, namely, an attempt to stretch a glide with or without a turn in order to get down onto the most attractive area available, and taking off in a steep climb with a disconcerting engine failure.

A wide range of airplanes was tested, ten in all, from the LeBlond-equipped Doyle, to the Curtiss Condor. The tests were run between 3,000 ft. and 2,800 ft. A sensitive Kollsman altimeter was used in conjunction with a bank of six stop watches which were automatically operated at 50 ft. intervals. The results are quite interesting.

Results are rather difficult to analyze as they are given in a table of vertical descents and behaviours, for each plane under the various conditions. Possibly the best solution would be to reproduce the formal conclusions of the paper verbatim.

1. Present day conventional airplanes will fall into a spin when a turn is attempted in a stalled glide, if they have sufficient longitudinal control actually to stall them.

2. Engine failure during take off will not of itself cause loss of control, or particularly dangerous vertical velocities.

3. Since all of the airplanes tested had satisfactory stability and control after engine failure in a steep climb, it is likely that serious accidents following engine failure during take off are due to the airplane striking the ground on one wing and its nose while in a turn, or to the airplane starting into a spin because of an attempted turn in a stalled glide following the engine failure.

4. Research aiming to increase the safety of aircraft should be concentrated on the development of satisfactory lateral stability and control throughout angles of attack as high as can be attained with the longitudinal controls available.

DATA ON COMBUSTION ENGINES

AUTOMOBILE AND AIRCRAFT ENGINE *by A. W. Judge; Second Edition; Isaac Pitman and Sons; 845 pp., illustrated.*

MOST books on engineering subjects are, to a greater or less degree, compilations of existing knowledge. They differ, essentially, in the extent to which the author selects, arranges and digests such knowledge and adds to it from his own thought and experience. To those familiar with Mr. Judge's previous volumes. It will not be surprising to know that in this one he has followed his usual course of offering a compilation of existing data, condensed to be sure, but with a minimum of comment or addition from the author himself. The result is a volume containing a great deal of useful information, but requiring of the reader an ability to select and co-ordinate which only those with considerable knowledge in the field can be expected to possess.

The present volume is a revision of a book of the same title published in 1921. Since that time much water, technically speaking, has run over the dam and it it disappointing to find that little attempt has been made to cull out matter which has become obsolete or irrelevant meanwhile. The new edition consists, essentially, of that of 1921 unchanged, except for the addition of new material.

Most of the new subject matter is contained in additional chapters, chief among which are those on "Recent Combustion Theories," the "Stratified Charge Engine," "Detonation in Petrol Engines," and the "High Speed Combustion Engine." Valuable material on the combustion process, chiefly from Ricardo, has been added to the first chapter, and a considerable section on crankshaft torsional vibration to the chapter on "Engine Mechanics." Judge is evidently a close follower of Ricardo, and it would be hard to find a better

leader in this particular field. The influence of Ricardo's work is evident both in the old and new material, considerable sections and even whole chapters being taken largely from publications by that author.

In justice to Mr. Judge it must be said that credit is generously and freely given in all cases, and valuable bibliographical references appear on nearly every page, supplemented at times by a longer list at the end of the chapter.

Unfortunately, examples of poor arrangement, and even misstatements of fact, are not hard to find. For example, the treatment of "detonation" is handled in widely separated chapters and under several different headings. The statement on page 566 "there is at present no evidence that turbulence effects detonation in any way" is certainly contrary to present experimental evidence. Another statement, this one on page 776, that gasoline "consists of pentane, hexane, heptane and octane" is so obviously erroneous as to lead one to doubt of its being proofread by the author. Unfortunately, these are not the only errors of fact that could be cited.

Although in general the book errs on the side of including too much data, even to the extent of contradiction in some instances, one regrets to discover no adequate treatment of the subject of carburetion, an omission common to most English works. It seems inexcusable, also, to have omitted the important work done in this country on fuel volatility, detonation, and vapor lock. The omission of the latent results on the influence of air temperature and humidity on engine performance, is also regrettable.

To call Judge the Pagé of England is scant praise, and yet the works of these two have much in common. Both are compilers of data on automotive subjects and neither uses too great care in selection, arrangement or digestion. Of the two, Judge is the more successful, the present volume containing much that is valuable, provided the reader has the ability to make an intelligent selection. —C. F. Taylor, *Massachusetts Institute of Technology.*

A COURSE IN FLYING

Flying from the Ground Up, *by R. Sidney Bowen, Jr., formerly managing editor of* Aviation*; Whittlesey House, trade division of McGraw-Hill Book Company, Inc.; 234 pages; $2.00.*

WRITTEN entirely in conversational form, this volume presents in a unique fashion the steps and phases of a complete course in flying up to the point of soloing. The author is the instructor, the reader is the student; the reader is addressed as if he were actually taking the course. This personal touch provides emphasis on many important points in a very effective manner.

This breezy informal method of presenting the average instruction course distinguishes the book from the usual discussion of the subject. It is based on Mr. Bowen's service with Royal Flying Corps during the war, and shortly after the war in Belgium, Germany, and Egypt.

There are ten chapters, each one representing a successive air hour in the student's progress. Description of each step is supplemented by diagrams of maneuvers, and manipulation of the controls in those maneuvers. Right and wrong methods, of course, are pointed out in both the text and in diagrams.

For instance, a diagram shows a plane in four attitudes of coming in, levelling off and making a three-point landing. Above each diagram of the plane is shown the position of the stick in each phase. In another example the reader is shown how to get into a field when the engine cuts out at various distances from the airport and at various altitudes. Use of spirals and side slips to enable the machine to land safely in spite of attitude of plane, distances, and obstructions are clearly indicated.

This is not a ground school manual; that is, it does not go into any more of the technical aspects than would be covered by the usual course which starts when the student appears at the field for instruction. However, the essential aspect of aerodynamics and the fundamental construction of all parts of the machine are worked into the lessons.

Because of its first person point of view, the book has many of the aspects of a narrative and thus is interesting to the qualified pilot as well as to the prospective one. This general interest is enhanced by the fact that it reflects one's own actual or anticipated experiences and serves to refresh the casual pilot on many important points. It is a valuable supplement to any actual course of flying instruction. — Charles H. Gale.

A MECHANIC'S HANDBOOK

The Aircraft Mechanic's Handbook, *by I. W. Miller; The McGraw-Hill Book Company, Inc., 1931; 170 pages; Price $2.*

BASED on a number of years' experience as a pilot and as engineering officer for several active Marine Corps flying units operating both in the United States and in Central America, Lieutenant I. W. Miller, now stationed at Quantico, Va., has written a practical handbook for the use of aircraft mechanics. The standards and methods set forth in the book are largely those of the government services, but good maintenance practice there should apply equally as well to commercial operations. Any one who has to do with the care and upkeep of airplanes of any type should find Lieut. Miller's notes as presented in this volume of considerable interest.

For an experienced mechanic the opening chapters may be found somewhat elementary, but they can be read with profit by the newcomer in the field. They deal largely with the proper usage of tools, and describe a number of shop operations commonly encountered in practice. The balance of the book includes a series of practical notes on such items as structural materials; tie rods, wires, and cable; application of fabric to airplane surfaces, including stitching and doping; airplane rigging; and the care and maintenance of engines and propellers. An outline of routine inspection for both airplanes and engines is included in Chapter X. Care and upkeep of airplane instruments is not treated in full as the only material of this sort is a short chapter on the servicing of magnetic compasses. Extracts from "Air Commerce Regulations" are of particular interest to the mechanic.

The volume is compactly arranged, and its overall size of approximately 5x7 in. makes it possible to carry conveniently in tool-kit or pocket.—S. Paul Johnston.

THE AIRPLANE IN MOTION

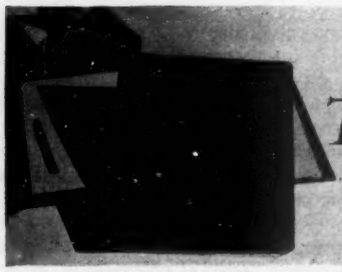
Manual of Flight, *by Captain Ilnar E. Elm; David McKay Company, Philadelphia, 1930; $3.00.*

THAT this, the latest of the flight manuals, should also be the best attempt so far in that direction, is an encouraging phenomenon. The manual is written for the private or prospectively professional pilot who intends to make full use of his opportunities. It is in no way a complete ground school manual nor should it be. The control of an aircraft in motion is the one and dominating subject of the book.

In addition to the necessary discussions of ordinary flying, landings, and aerobatics, there is a constant introduction of suggestions for good airmanship, candid considerations of difficulties, and of emergency situations. It is not to be absorbed in one reading, rather there should be material here for constant reperusal between a pilot's zero hour and his two or three hundredth.

Finishing a description of an Aileron Roll on page 88, Captain Elm continues —"To fly a circle, making the entire course a continuous series of aileron rolls, has not, so far as I know, been tried, although it offers wonderful opportunity to exercise the synchronization of controls, comparable to finger exercises on the piano. After that has been done successfully, a rolling loop holds forth still greater possibilities."

Finger exercises for students indeed! Compared to this the formerly admired gyrations of a Williams or a Doolittle are as dissonant as "chop sticks."—Daniel Sayre.



The Salesman's Notebook

When Manufacturer and Dealer Meet

WITH the introduction of its 1931 line of commercial planes, Curtiss-Wright established an interesting precedent in aircraft sales programs. This was the assembling in February of about 200 of its dealers and representatives at St. Louis for a series of conferences and factory demonstrations—a new method for the aviation sales organizations, though one which has long been standard practice in other industries, notably the automobile field.

Most of the advantages of a country-wide launching of another year's sales effort are obvious, but one by-product of this particular meeting deserves mention. It afforded a valuable check on the company's rather radical step in placing so much emphasis on the very-light plane market. The dealers' immemediate reactions to the plan and the product helped reduce the element of gamble in the exploitation of a new field; they enabled widespread opinion on technical aspects and saleability of the new models months in advance of what could be obtained under the usual method of distribution. And the company actually launched its production program backed by about 200 orders on which 25 per cent deposits had been placed.

Dealer groups visited St. Louis by geographical divisions, each group spending about two days at the plant. On the morning of the first day officials outlined the company's policies, presented pertinent sales statistics and general information about the company, and discussed sales practices. Then the new models were paraded before the group and flown off by company pilots in an aerial demonstration. Following lunch each plane in turn was wheeled into a curtained-off area in a hangar and displayed as though on the floor of a showroom. Salesmen "sold" them to the dealers as they would be expected to sell to their prospects.

On the second day half the group visited the factory while the other half flew the machines, then the assignments were reversed. Thus every dealer was able to inspect each model in the air as thoroughly as he did on the ground.

Opinion was crystalized in the form of questionnaires which each pilot filled out after each flight. By a check mark in columns headed excellent, very good, fair, unsatisfactory, he indicated his reaction to every performance detail-such as lateral stability, rate of climb, take-off run, and so on. Summarized, these opinions provided a valuable index of the general reaction. So seriously were these comments taken that it was decided to make one a three-place instead of a two-place model, and to major the less expensive models.

The psychology and the good policy of providing an opportunity for the individual dealers to express their own opinions are obvious. Coupled with this questionnaire was a form which the dealers could use to place their orders, to be accompanied in every case by the deposit. In this way more than $250,000 worth of the new line, about 75 per cent of them Juniors, was contracted for in the two-week period. Following the receipt of the orders from each group, dealers drew lots for delivery date. The company has been working on a 24-hour basis shaping its production program to meet these orders.

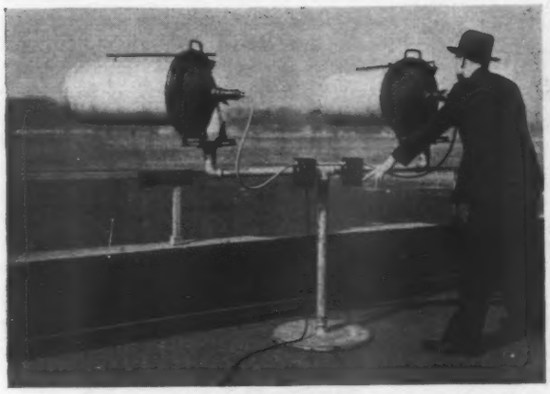
Airport Management

Eating Facilities at the Airport

ADEQUATE and attractive eating facilities with food of acceptable quality seem to be difficult to achieve at most airports. One of the most satisfactory port restaurants in the East is at the Boston Municipal Airport. The accommodations and food are attractive, the patronage already is fair and is increasing; it is expected that at the present rate of growth a profit may be shown soon although up to the present there has been a deficit.

The present concessionaire, a professional restauranteur, has been in charge but a few months, during which the daily income has been built up to an average of about $80. Approximately 380 meals are served daily. Since the city is paid $2,400 for the concession the first year (under terms of the bid), $3,000 the second year and $3,600 each year thereafter, it is obvious that patronage must increase. Much of this is

A group of dealers and representatives at the Curtiss-Wright sales conference



Luther Harris, maintenance manager of the Ludington Lines, demonstrates the dispatch "guns"

coming from the general public living or working in the vicinity of the airport, as well as from additional employees or users of the field, though no formal advertising or promotion is done. It is the practice not to depend too much upon income from week-end crowds.

The restaurant includes a cafeteria and a lunch counter. The former is in the front of the administration building and overlooks the field. The latter is in a separate room at the rear of the cafeteria and has two entrances, one of which is directly from the field. The lunch counter is provided particularly to accommodate pilots and mechanics wishing to take but a short time from work. Flying suits and overalls are the usual garb. About 250 are served each day in the lunch room, the average check is 10 or 15 cents. The average check in the cafeteria is 40 cents and about 120 are served daily.

Traffic Control at Washington Airport

IN ORDER to handle effectively the increasing number of daily take-offs at the Washington Airport at Washington, D. C., a new system of signal lights similar in principal to the one in use at Croydon, England, has just been installed in the control tower. Located on the roof just outside of the chief dispatcher's office, they can be readily seen from all points of the field, and the operator has an unobstructed view not only of all runways, but of all the surrounding air space.

The unit consists of two spotlights mounted on a cross arm about 6 ft. apart, the latter supported on a pipe pedestal and so arranged that it can be swung to any desired angle horizontally. Each lighting unit is separately adjustable vertically, and is equipped with a cylindrical galvanized iron shield, or barrel, which concentrates its rays so that they are visible only from that small area on the field toward which it is pointed. Attached to each barrel, and parallel to it, is a piece of ⅜ in. common gas pipe, through which the operator sights to direct the light beam. Each light is separately controlled from a switch mounted on the cross arm. All controls are extremely simple and a single operator can readily focus either light at any desired point on the field.

One of the lights is equipped with a red lens and the other with a green one. An airplane about to depart taxies out to position at the head of the appropriate runway. While running up the engines the plane is allowed to remain at 90 deg. to the runway, and the pilot waits in this position until he receives the signal from the control light.

The signals in use are as follows: red—stop, do not take off; green—turn, and take off at once; red and green —return to the loading platform. Pilots and dispatchers alike have reported that the new system has proven very effective in handling peak hour traffic on the airport.

The Control System of Newark Airport

WITHIN the last twelve months, Newark Municipal Airport has become one of the busiest air transport junctions in the United States. High frequency of arrivals and departures over Colonial, Eastern Air Transport and Ludington Lines, and operations of N.A.T. and Transcontinental & Western Air are further complicated by a better than average amount of miscellaneous flying. With all this activity the method of traffic regulation and general field supervision becomes very important. A simple flag control system suffices, however.

Operations are divided distinctly into transport and miscellaneous; the latter includes charter, transient, sales demonstration and student work. All transport operations, with the exception of temporary housing and servicing the planes of two companies, are conducted on the east side of the field. The rest is concentrated on the west side along the original hangar line. The two are co-ordinated through the field superintendent T. J. Donnelly, of the city's official airport staff.

Transport planes must be taxied along a strip 50 ft. wide parallel with, and to the east of, the north-south runway, just outside the east boundary lights. After landing, the machines must turn right off the landing area on to the taxi strip as soon as possible.

The signal system for takeoff of passenger machines is standard for all companies, but is operated by each company as its machines leave. An employee stands in a prominent position on the airport and holds aloft a red flag as the machine taxies to a takeoff position. The red flag is displayed until all is clear and then a white flag is raised, the signal to the pilot to take off. There is no set of signals regulating landing.

Miscellaneous operators basing the field observe the usual traffic regulations in effect at the average airport.

The airport has not published a set of field regulations but issues special instruction bulletins when occasion arises.

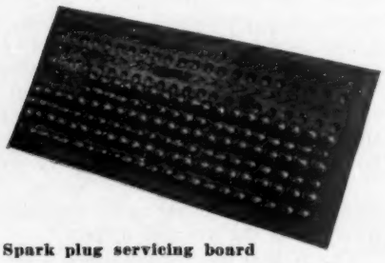
The cafeteria at the Boston Municipal Airport. The windows at side and end overlook the field and hangar lines.

Servicing Short Cuts

SERVICING SPARK PLUGS

LARGE scale airline operations involving frequent schedules and a large number of airplanes, make factors which ordinarily are rated as minor details of first rate importance. As almost 600 spark plugs are in daily use on the Stinson airplanes of the Ludington Lines, servicing from the standpoint of both reliability and economy becomes a major problem. With about 250 spark plugs in reserve the total number in circulation is close to 850, of which 75 or 80 are routed through the Washington shops every day.

Every morning all spark plugs removed from engines on the previous day are delivered to the engine repair shop in tin trays. As in all other operations at the Ludington Shops, the same man is assigned to the same job every day so that each becomes an expert in his particular line. The servicing routine is invariable, and all plugs are carried through each step before passing on to the next. Nine distinct operations are performed before they are again ready for use.



Spark plug servicing board

(1) The first operation consists in loosening the two halves by means of a pair of socket wrenches. Copper gaskets are examined at this time and rejected if they are too flat for further use.

(2) Each plug is dissembled by hand and the two parts are placed on a specially designed plug board. The board is made up of a piece of soft wood about 18 in. wide and 36 in. long, equipped with ten alternate rows of holes and headless wire nails, the latter projecting about 2 in. above the surface. After disassembly each shell is placed over a nail, and the corresponding center electrode dropped into the hole immediately in front. In this way the two parts are kept together through all subsequent operations and can be re-assembled without danger of mixing with parts of other plugs.

(3) The shells are cleaned on the outside by holding them against a rotating wire brush. Inside cleaning is accomplished by forcing them over a rotating wire brush of smaller diameter. Both brushes are mounted on the spindle of an ordinary motor grinder.

(4) Electrodes are given a preliminary cleaning by buffing on the wire brush.

(5) All electrodes are chucked in turn in a small speed lathe, and the points are given a final polish with fine crocus cloth.

(6) After final polishing electrodes are given a flash-over test, which consists in placing each in turn over suitable contacts and impressing high voltage across it by means of a hand driven "booster" magneto. A small air gap is connected in parallel with the electrode, and, in case the latter is shorted, no spark appears at the air gap, and the plug is rejected.

(7) After the flash-over test the two halves of the plugs are loosely assembled by hand.

(8) The two parts are tightened and the electrode clearances set by means of a special jig and feeler gage.

(9) As a final operation all plugs are given a bomb test to check clearance and general operation. The bomb consists of a small pressure chamber into which the plugs can be screwed. The points are visible under a small glass window. Air up to 150 lb. per sq. in. can be admitted to the chamber, and high voltage applied to the plug terminals by means of the booster magneto. If a spark appears at the parallel external air gap before air pressure of 100 lb. per sq.in. is reached in the bomb, the plugs are returned for readjustment, or discard.

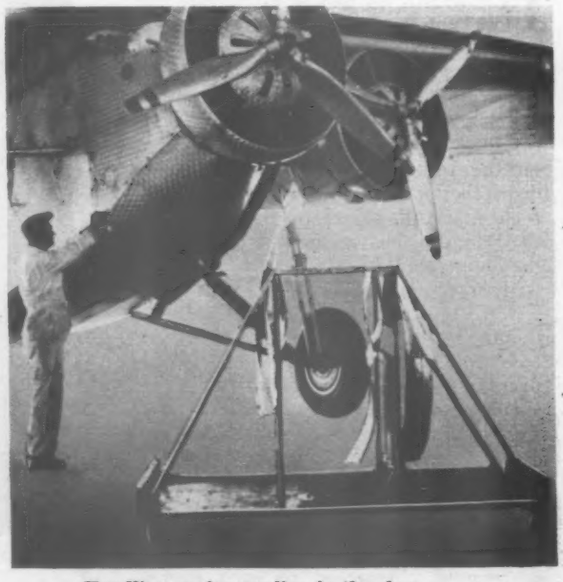
Spark plugs which successfully pass the bomb test are ready to be returned for engine service, and are turned over to the line crew. The average rate at which one man can handle plugs through the above routine is from 25 to 30 per hr. It is of interest to note that by working in close co-operation with manufacturers, the number of plugs rejected for electrical or mechanical defects has been reduced from an average of four or five, to about one per day, and that the total life of plugs is now better than 500 engine hours.

HANDLING ENGINE COWLING

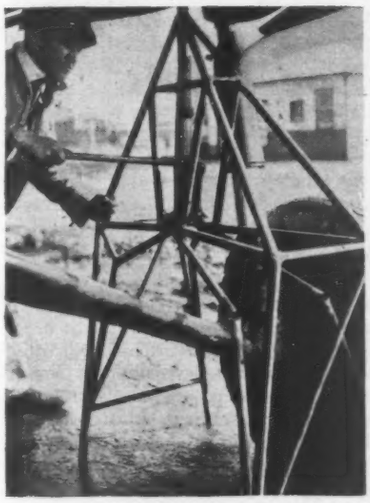
HANDLING of engine cowling in the service shop of the western division, T. & W. A., Inc., has been greatly simplified through the use of a portable cowling rack mounted on casters. The rack has three sections, one for the cowling of each engine, and is provided with hooks upon which the cowling is hung. When an engine is being serviced the cowling is removed, hung on the rack, and pushed back out of the way. This saves needless carrying of the cowling, avoids cluttering up the working area, and prevents injury to the cowling through handling.

JACK FOR WHEEL SERVICING

FOR repair or replacement of wheels, brakes, or shock absorber struts, the Washington Shops of the Ludington Lines have developed a hydraulic jack arrangement which permits such work to be done on their Stinson tri-engined airplanes in a minimum time. A rigid



Handling engine cowling in the shop



Wheel servicing jack in operation

welded steel tube framework, designed to straddle the landing wheel struts and axles on the inboard side of the wheel, supports a commercial 6-ton hydraulic jack below, and in line with, the shock strut fitting of the engine nacelle. A steel mandrel, resting on the head of the jack and supported in a guide bushing welded to the framework, transmits the thrust to the nacelle fitting. Raising the jack transfers the load from the wheel and shock absorber to the steel framework, permitting any part below the nacelle to be removed without any tendency for the airplane to shift, or to tip over. Other servicing work on the plane may be carried out at the same time without danger of disturbing the balance. The whole operation can be handled easily by one man, as the stand is light enough to be carried about over the shoulder. When not in use in wheel servicing, the jack may be lifted out and used for any other desired purpose in the shop. By the use of this equipment repairs or adjustments to the landing gear may be made on the apron, or on any level area on the field.

ECONOMY IN THE SHOP

THE average mechanic is prone to judge the value of tools or parts by their relative size, and often carelessly tosses them aside, or mishandles them without regard for their real worth. In order to guard against this form of waste (which is surprisingly large in many cases), every man in the shop of the New York, Philadelphia, Washington Airways, Inc., at Washington is informed verbally of the exact cost of any tools or supplies which he draws from the stock room. By this simple system everyone on the repair and servicing crews looks at such supplies not as "just another spare part" but as so many dollars and cents for whose best use he is directly responsible.

What Our Readers Say

Dead Stick Landing Contests

TO THE EDITOR:

It seems as if it is the attempt at many airport dedications, air races, etc., to thrill the public as much as possible, leaving the general impression that air travel is as yet a breath taking sensation that is to be tried by only the daring. However, an event is held at most of these meets that is of only slight interest to the average person, although it answers a question that is no doubt in the minds of the majority of the people.

This event is none other than the well known dead stick landing contest, which is in reality a misnomer. It would be more logical to call it the dead engine landing contest, since the stick is one of the important controls used in bringing the plane down to the desired spot. instead of being an inert factor as the general impression is when the misleading name is used. It would be desirable to offer larger prizes to attract the more skillful pilots and play up this exhibition more than is done. Doesn't it answer the question, "When the engine stops on a plane, isn't it true that it drops like a plummet?"

This event could be run off at varying altitudes, none of which should be less than about 1,500 ft., in full view of the grandstand spectators instead of to one side as seems to be the general idea. Thus by proper play up, the mental resistance that often exists before a person's first flight will have been reduced in many instances and more prospects made available for the air transport lines.

H. A. LINDBERGH,
Minneapolis, Minn.

The Seaplane's Advantages

TO THE EDITOR:

Aside from purely sport flying, I feel that the chief value of the airplane undoubtedly lies in its convenience and the saving of time. We all know that the present-day plane is a fast and reasonably comfortable vehicle. The reason it is not a larger saver of time and a true convenience is because we generally have to spend from a half to three quarters of an hour in order to reach an airport and get under way, and the same amount of time is wasted when we arrive at our destination.

I believe that under existing airplane requirements, it will never be possible to place airports any closer to the centers of population. On the other hand, potential seaplane bases exist in the very heart of a great many of our largest cities. New York, Chicago, Buffalo, Cleveland and Detroit are only a few typical examples with which I happen to be familiar, and it would appear that all of them could be provided with municipal bases at comparatively little expense.

From the standpoint of organized airlines, the excellent 55 minute Thomson Aeronautical Amphibion Service from Cleveland to Detroit is to my mind a perfect illustration of what can be accomplished. The importance in saving of terminal time, which they affect, will of course apply particularly to the short hauls of two or three hours flying, but there are any number of runs in the country which are well adapted to a similar form of service.

Another important phase is the commuter's problem. Most men who can afford to own or rent airplanes for their private use have the means and desire to go away from week-end trips during the summer, and the majority of them seek the seashore or lake resorts. In many cases there is an opportunity to land a seaplane or flying boat close to, and often times immediately in front of, their destination, and in some cases a water landing is the only possibility. Our problem is to show these men a real saving of time through flying, and there is no question but what the development of adequate seaplane bases in the larger cities would make flying of real value to people who under the existing conditions would not consider it.

There is one other point which may be a little aside from the subject, but which I cannot refrain from bringing up. The aircraft industry today is greatly handicapped through lack of confidence on the part of the public. Anything we can do to make flying safer and, what is equally important, make it appear safer, is of the greatest value. I am sure you will agree with me on the advantages of water flying from the safety standpoint, through reduction of the forced landing hazard and other correlated contingencies.

I believe that the public already feels that seaplane flying is really safer, and is more willing to embark on an over water as compared to an over land flight. Perhaps the close relation to the sensation of fast motor boating partially explains it. Undoubtedly the fact that the seaplane can fly comparatively low with safety and allow passengers a much better view of the country, is another appeal.

The cost of building seaplane runways or floating barges is insignificant

as compared to the purchase of land and the development of the average municipal airport. We already have the ships with over forty different types of land planes licensed on floats and a wide range of excellent amphibions and flying boats. What we need is the bases in order to develop a field which holds so much natural promise and has been so sadly neglected to date.

GEORGE B. POST,
Vice President,
Edo Aircraft Corp.,
College Point, N. Y.

Visibility and Safety

TO THE EDITOR:

While much stress has been put on making aviation safe, it seems to me that one very important phase has been overlooked. That is the matter of visibility.

As the planes, especially cabin planes, are constructed the visibility of the pilot above and to the rear is practically nil. With the increasing air traffic, especially around metropolitan airports, it would seem that the pilot should have ample facilities to assure himself that nobody is liable to run him down. This seems to be especially applicable to large airports where student instruction is carried on, for in open cockpit planes the visibility below and forward is very much restricted.

With a cabin plane coming in to land and an open cockpit plane to the rear and slightly above the cabin job, neither one can see the other and that situation has all the chances in the world for a grand crash. The same holds true with a cabin plane taking off and an open job coming in to land.

It would seem that the Department of Commerce should require cabin planes to have the pilot's cockpit so arranged that they can see the rear and above.

Another point to be brought up is the matter of having the wings of a plane so colored, that they are visible from above and below. Many planes are now painted with international orange on the wings or other colors approaching it as far as visibility is concerned. It seems only right that there should be some ruling on this question to compel all planes to have their wings painted with a color of high visibility. On a hazy day a silver wing is indistinguishable and is hard to pick out on even a find clear day. In the interests of safety in flying it would help a lot to have a uniform highly visible color required on the top and bottom of the wings of all aircraft.

GORDON K. BERRY
Northbridge, Mass.

[The dangers to which Mr. Berry refers are very real ones upon which we have commented editorially from time to time. His suggestion of compulsory use of high visibility coloration on planes, especially on the upper surface of the wing, has a great deal to recommend it, and it may well be necessary to take some such measures in the near future.—Ed.]

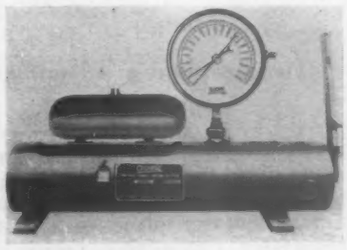
The Buyer's Log Book

Aerial Flares

THE carrying of flare equipment for emergency illumination is essential in all night flying operations. A complete line of flares and signal lights put up in a form which makes for convenient operation is marketed by the International Flare-Signal Company of Tippecanoe City, Ohio. This equipment is manufactured under the Driggs-Faber patents and includes two mediums of firing—(1) projection of signal and flares, (up to 200,000 cp.) by means of a pistol, and (2) projection of a large landing flare by electrical ignition from a tube or barrel, more or less permanently installed in the airplane. The pistol type is built along the lines of a .45 calibre automatic with a somewhat larger grip and trigger to facilitate use with a gloved hand. Interchangeable barrels and projectors are provided to permit the use of different color signal lights. The latter can be had in either parachute or meteor types. The landing flare affords longer illumination than is produced by the pistol type. Between 500,000 and 600,000 cp. is available for three minutes. The flares are fired electrically and are provided with a delay fuse which prevents their igniting until the projectile is well clear of the airplane from which it has been fired. A firing switch is provided which is so arranged that flares cannot be accidentally ignited in case of a crash. —AVIATION, *May, 1931.*

Weld Tester

IT IS often desirable to have means available in the shop to conduct periodic tests of welding operators, or to test random specimens collected by the inspector from completed work. A piece of apparatus for this purpose has been marketed recently by the Oxweld Acetylene Company of New York. The machine weighs 155 lb. and measures 28 in. in overall length by 6¾ in. in maximum diameter. It is self-contained and fully portable, and may be taken to any part of the shop or field where test is desired. The machine consists of a tubular compression member with a set of grips in the head and a hydraulic cylinder block in the base. The cylinder block contains a communicating pump and cylinder machined into a single block. The specimen is placed between the jaws and tension is applied by operating a pump handle at the head end of the machine. The load is measured directly in pounds per square inch on a suitably calibrated pressure gage. Specimens may be stressed up to 40,000 lb. per sq.in.—AVIATION, *May, 1931.*



Portable weld tester, complete

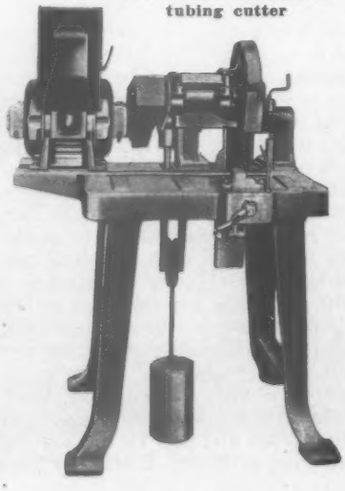
Glossy Dope

TITANINE, Inc., of Union, Union County, New Jersey, is marketing a complete line of high-visibility aircraft colors in pigmented dope which dries with a high degree of gloss without polishing. It is reported that the flexibility, hardness, and adhesion are such that the dopes may be used equally well over fabrics, properly primed metal, or properly filled plywood. This factor simplifies shop work, as the same material may be used on many different airplane parts. The new dopes are a development of the No. 981 line announced about a year ago.—AVIATION, *May, 1931.*

Tubing Cutter

FOR use in stock rooms where tubing, bar, rod, of practically any material must be cut into lengths, a machine

The Campbell abrasive tubing cutter

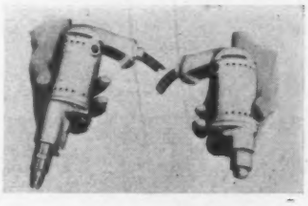


is being manufactured by Andrew C. Campbell, Inc., of Waterbury, Conn. The material is clamped solidly on the table by a special fitting and the cut is made by a motor-driven friction disc mounted on a counter-balanced arm which swings down through the work. The entire unit is self-contained, incorporating the motor and necessary starting switch.—AVIATION, *May, 1931.*

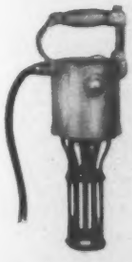
Electro-Viscometer

IN SPRAY finishing operations with paint and lacquers trouble frequently arises from orange peel, dusty work, sags, etc., which may be due to inaccurate thinning or lack of viscosity control. An instrument has been designed and placed on the market by the De Vilbiss Company of Toledo, Ohio, by means of which the consistency of painting material may be controlled.

The instrument is completely portable and requires no technique or training to operate. An attachment plug is connected to any light socket and the instrument adjusted to the proper potential by means of a control dial. The impeller mechanism is then immersed in the liquid to be measured (in its original container), the push button on the handle is pressed and the consistency of the liquid (in De Vilbiss units) is read directly on the viscometer dial.—AVIATION, *May, 1931.*



The Black and Decker "Universal Twins"



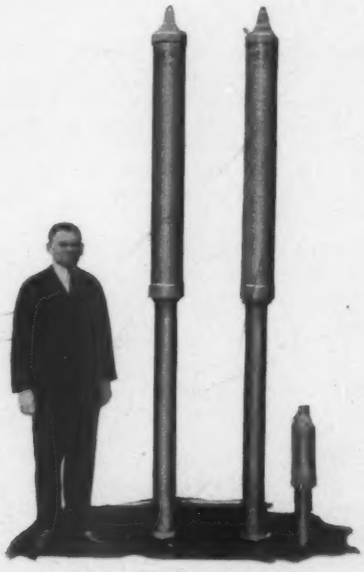
The De Vilbiss electro-viscometer

Two New Tools

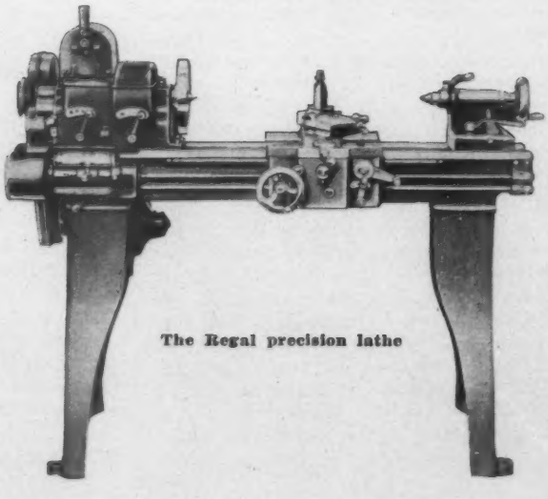
TWO exceptionally handy tools have been announced by the Black and Decker Manufacturing Company of Towson, Md., as a part of their portable electric tool line. The "Universal Twins" consist of a ⅜ in. electric drill and a small electric screw driver. They are extremely short in length and diameter and are particularly adapted for working in close quarters. The screw driver is equipped with an adjustable friction clutch which automatically releases the force on the screw once it is driven home. Both tools can be furnished for 110, 220 or 250 volts.—AVIATION, *May, 1931.*

Giant Struts

BUILT to support a transport plane carrying 50 passengers, or a maximum normal load of 25,000 lb., the world's largest aerol shock-absorbing struts have been constructed by the Cleveland Pneumatic Tool Company of Cleveland, Ohio. They weigh 142 lb. each, have a 7-in. diameter and have an extended length of 113 in. In flight they can be retracted to 64 in., their minimum length. They are so large that a strut, designed for an ordinary-sized transport plane, will be used with them as a tail skid shock absorber.—AVIATION, *May, 1931.*



Strut for a 50-passenger transport



The Regal precision lathe

Precision Lathe

TOOLS of a type which would find use in the repair and maintenance shops are the Regal precision lathes recently placed on the market by the R. K. LeBlond Machine Tool Company of Cincinnati, Ohio. The machines are individually motor-driven and incorporate a fully enclosed geared head and selective geared feed box. They are built in five standard sizes ranging from 10 in. to 18 in. swing. They may be purchased on a deferred payment plan.—AVIATION, *May, 1931.*

Seaplane Anchor

AN anchor which may be folded for storage into a very small space and which has been used successfully on board seaplanes is offered for sale by the E. J. Willis Company of 85 Chambers Street, New York City. Weights of 5, 10 and 15 lb. are available. It is claimed that a 15-lb. "Eze-sto" anchor will hold a 30-ft. cruiser in open water.—AVIATION, *May, 1931.*

Draining Cans

WASTE cans admirably suited for draining oil sumps, carburetors, or radiators have been developed by the Dover Stamping Company of Cambridge, Mass. It is such specialized but simple equipment which often makes for orderly and efficient maintenance hangars.—AVIATION, *May, 1931.*

A New Paint

PAINT material which is claimed to withstand temperatures up to 1,200 deg. F., without discoloration, and to remain effective as a protective coating up to 1,800 deg. F. is marketed by the Ultra Fuzon Distributing Company of 245-249 West 27th Street, New York City. The material is put up in powder form to be mixed before using with a thin bronzing liquid. The basic element of the powder is finely divided aluminum. Satisfactory results have been reported on the use of this material as a protective coating for airplane engine exhaust manifolds.—AVIATION, *May, 1931.*

Ball Bearings

THE use of ball bearings throughout airplane control systems seems to be rapidly on the increase as design

details are perfected, and several ball bearing and pulley companies already offer more or less complete lines for these uses. An interesting development is an especially designed bearing for torque tubes developed by the Fafnir Bearing Company of New Britain, Conn. Due to the tolerances on seamless aircraft tubing the bores of the bearings are made $\frac{1}{8}$ in. larger than the nominal tube diameter so that a sleeve can be fitted between the tube and bearing. An abutting shoulder for the bearing can also be built on this sleeve.—AVIATION, *May, 1931.*

Catalogs

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Northrop Aircraft Corporation. An excellent example of modern catalog make-up has been received from the Northrop Aircraft Corporation of Burbank, Cal., describing the new Northrop "Alpha." The descriptive matter is well handled and the cuts of the assembly and details are unusually well done. The motif is modernistic throughout.

Berry Brothers, Inc. The fifth edition of the bulletin entitled "Specifications for Aircraft Finishing," published by Berry Brothers, Inc., of Detroit, Mich., has been received. This bulletin covers the problem of aircraft finishes in a general way and describes specifically the various products which they manufacture for various aircraft uses. Notes covering the design and equipment for an aircraft dope shop are included.

The Bird Aircraft Corporation. A catalog describing the new four-place Kinner-Bird Airplane has been received from the Bird Aircraft Corporation of Glendale, Long Island, N. Y. The bulletin is illustrated with numerous photographs, and the complete specifications for the machine with three optional power plants are given.

Walter Kidde & Company, Inc. A bulletin has been received from Walter Kidde & Company, Inc., of 140 Cedar Street, New York City, describing the "Lux" Aircraft Fire Extinguisher and their application to various types of airplanes. Full description and prices of equipment for single and multi-engined airplanes are given.

General Electric Company. Shops conducting extensive gluing operations will find Bulletin No. G. E. A.-193 A, issued by the General Electric Company, of Schnectady, N. Y., of interest. A complete line of electrically heated glue pots is described in this circular.

Atlantic Metal Hose Company. Several types of flexible metal hose and hose accessories designed for various purposes are described and priced in the new bulletin of the Atlantic Metal Hose Company, Inc., of New York, N. Y.

Side Slips

By ROBERT R. OSBORN

PRICES were being reduced so rapidly and suddenly at the Detroit show that most of the salesmen were running out of their booths to buy early afternoon newspapers for the latest quotations on their own products.

If we're going to have these price wars at each year's show, with the great worry overnight as the next morning's announcements of one's competitors, we'd suggest quoting prices "L.T.C." which means, of course, "Less Than Competitor."

There had been many questions why the show building was kept so hot most of the time until it was discovered that the same man had bought both the heat and the ginger ale concessions.

One exhibitor certainly left his guard down when he showed his luxurious amphibion with a chess board as standard equipment. His competitors were soon pointing out that their ships were so fast there would be insufficient time to play chess on any trip.

Sometimes we get completely discouraged about this here, now, column, and become more convinced that no one ever reads it. After all of our recent complaints that ladies' aeronautical ventures should be better and more completely reported, by the fashion editor if possible, the United Press turns in only these few words about Miss Earhart's altitude record in an autogiro, "Miss Earhart was clad in an electrically heated, fur-lined flying-suit."

The following was clipped from the New York *Herald Tribune* by H. S. M. on April 1, and the date line may explain the whole item: "RADIO LANDS PLANES IN FOG. Answering the telephone without first making a trip to turn off the radio and making a second trip to switch it on again, is now possible with a remote control for the radio set attached to the telephone, says Popular Mechanics Magazine."

Mr. I. K. McW., who seems to be our official attention caller from down Dallas way sends in a couple of items from the local papers: "JACK FROST TO BE FOUGHT WITH PLANES TONIGHT. San Benito, March 2 (Special to the Herald) If Jack Frost visits the valley Monday night he is going to get the surprise of his life. According to J. E. Bell, secretary of the San Benito Chamber of Commerce, the Thomas Morris Produce Company, of this city, is to experiment with a new method of keeping the frost from doing damage.

"The company owns about 250 acres of beans near Raymondville and two airplanes will be stationed near the field. The pilots will watch the thermometers closely, and when the mercury drops to where the frost will form, the planes will take to the air and fly back and forth across the field, creating an artificial air current which, the company hopes, will keep the frost away."

I. K. McW. reports that the airplane won by default, as Jack Frost failed to show up, but the standby charges were enough to remove a little frost from the payroll of the company operating the airplanes.

With the comment, "Another one of those unusual things that happen in this 'magic valley'—caused perhaps by the high humidity." Mr. I. K. McW. also reports the following:

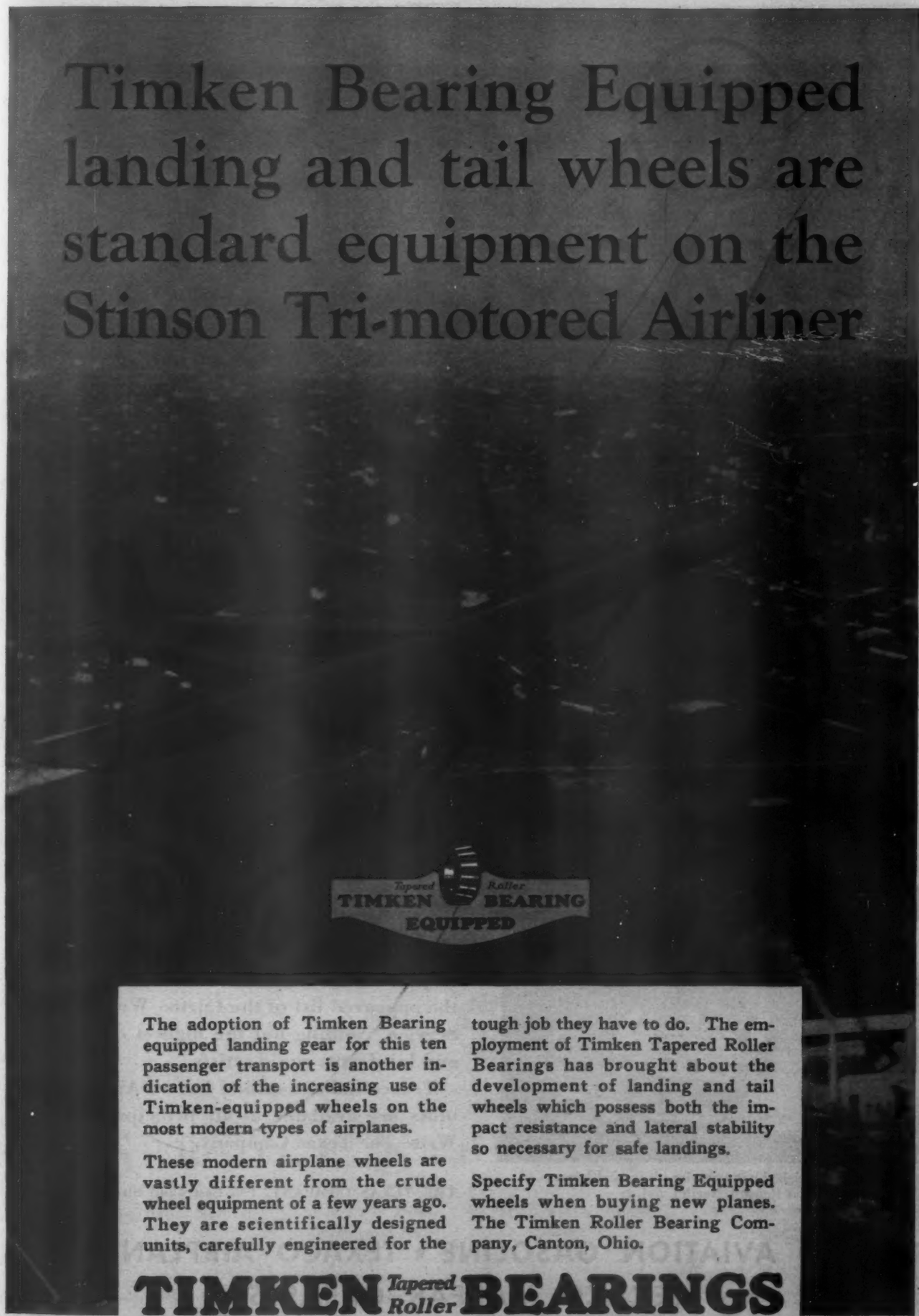
"VALLEY PLANE TO TRY FOR RECORD. Mercedes, March 11. Miss Rio Grande Valley, the airplane in which Wallace Hurley, 17, plans to fly from Los Angeles to New York in an attempt to break the existing junior transcontinental record, was purchased in Wichita, Kan., Tuesday afternoon, according to a telegram from Earl C. Darfler, who is handling arrangements for the flight. The plane is a Cessna Mildew winged monoplane—."

The Intrepid Aviator says he sees where some chap has invented a device to tell the pilot when he is loading his wings to the danger point by lighting a red light on the instrument board. He hopes the Department of Commerce won't require him to install one on his Jenny as the thing is hard enough to fly as it is without having a red light glaring in his eyes all of the time.

Our Hangar Flying Department

Roger Williams claims it as a true story and says it happened to a friend of his out west. He had an old OX biplane with no brakes, which was very hard to handle in a wind. One day he was caught in a narrow part of the field when it was very windy and his passenger got out to pull him around by the wing tip. A group of negroes were working nearby and one of them remarked to his mate: "I'd never ride with that fellow. Suppose he wanted to make a turn up in the air. I'll bet I'd be the one who'd have to get out to pull the plane around."

Timken Bearing Equipped landing and tail wheels are standard equipment on the Stinson Tri-motored Airliner



The adoption of Timken Bearing equipped landing gear for this ten passenger transport is another indication of the increasing use of Timken-equipped wheels on the most modern types of airplanes.

These modern airplane wheels are vastly different from the crude wheel equipment of a few years ago. They are scientifically designed units, carefully engineered for the tough job they have to do. The employment of Timken Tapered Roller Bearings has brought about the development of landing and tail wheels which possess both the impact resistance and lateral stability so necessary for safe landings.

Specify Timken Bearing Equipped wheels when buying new planes. The Timken Roller Bearing Company, Canton, Ohio.

TIMKEN *Tapered Roller* **BEARINGS**

TEXACO

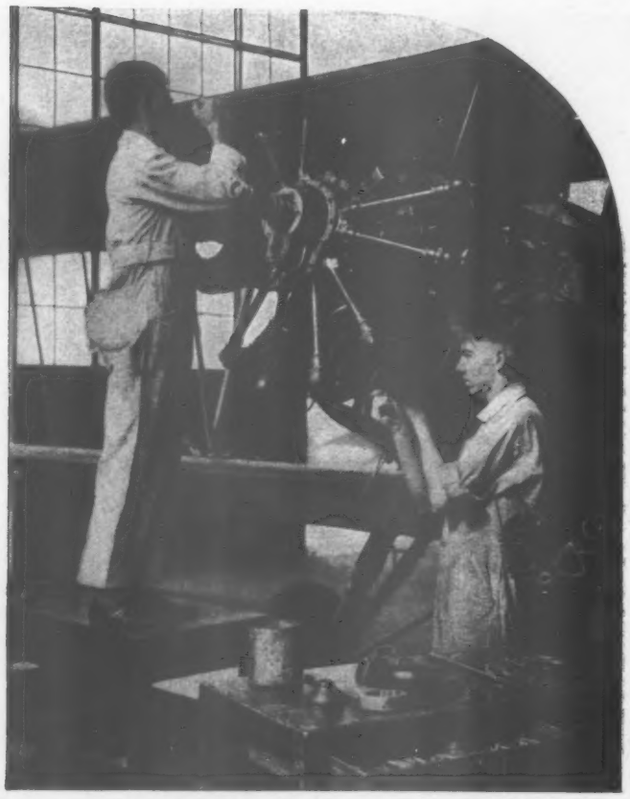
REG. U.S. PAT. OFF.

TEXACO
at
Curtiss-Wright
Flying Service Bases

One of six Curtiss-Wright Flying Service hangars at Valley Stream, L. I.

The Curtiss-Wright Flying Service hangar at the Dalworth, Texas, airport

Curtiss-Wright Flying Service planes and hangar at Raleigh, North Carolina



Repair Shop at one of the Curtiss-Wright Flying Service Bases. Texaco Marfak Grease will be applied to rocker arm assemblies.

CURTISS-WRIGHT Flying Service, with 30 important bases throughout the United States, is known everywhere in aviation circles for the exceptionally high type of service and the completeness of its facilities for inspection, repairs and parts replacement.

Texaco Airplane Oils and Texaco Marfak Grease, for the effective lubrication of rocker arm assemblies, are available at all the Curtiss-Wright Flying Service Bases. Texaco Aviation Gasoline is now in distribution at ten of these airports. All Texaco Aviation Products are on the approved list of the Curtiss-Wright Flying Service. Nothing but the highest quality fuel and lubricants could satisfy.

Texaco Lubricants and Texaco Aviation Gasoline are available at all principal airports. Write The Texas Company.

THE TEXAS COMPANY, 135 East 42nd Street, New York

TEXACO AVIATION GASOLINE • TEXACO AIRPLANE OILS
TEXACO MARFAK GREASES

★

Better Tubing
Helps To Build Better Airplanes

★

NEARLY all aircraft manufacturers whose desire is to produce the best airplane they know how to build use Seamless Steel tubing. An ever increasing number of them use "Service" Seamless Steel Aircraft Tubing for they have found large production orders of "Service" tubing shipped from the mill to be constant in strength, size and analysis. A monthly stock list of nearby warehouse stocks ready for instant delivery will be mailed upon request

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19 Scott Street
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B G

MICA AVIATION SPARK PLUGS

(Patented in the United States and Other Countries.)

Considered from the only standpoint that is really important, that of superior and uniform service, B. G. Mica Aviation Spark Plugs are *highest* in flying safety and *lowest* in service cost. They are made of the best materials throughout, insulated with selected mica which is the only insulating material that will withstand mechanical abuse and meet all the demands of modern aviation engines. They are wrought by specialists, every one of whom is a craftsman at his particular bench. Severe testing and meticulous inspection prove the high uniform quality of every plug. Unremitting efforts to improve an already *good* product—constant striving to make a *better* plug—have resulted in the unquestioned leadership of B. G. throughout the entire aviation industry.

B. G. Eliminates Ignition Interference

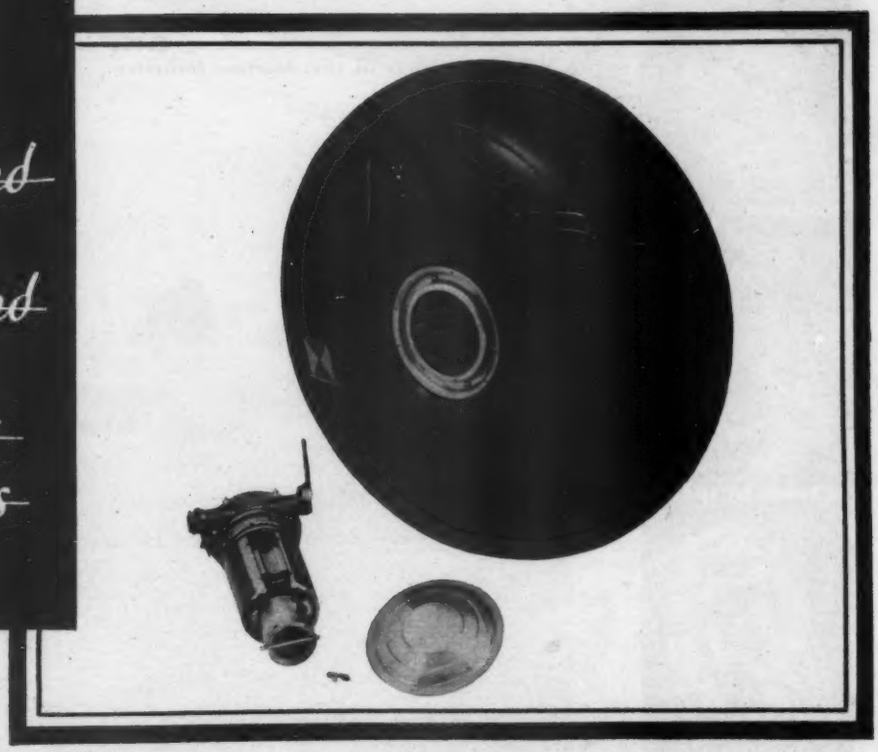
This new B. G. radio shielded spark plug—in conjunction with shielded magnetos and harness—eliminates all ignition interference, keeps out dirt, water and oil and gives positive contact. It is insulated with mica—the superior insulating material. It has standard shell and core hexes, is easily serviced with standard B. G. tools, and can be assembled to harness without solder. Terminal connections fit any make of shielded harness, and are interchangeable on all B. G. radio shielded plugs. The threaded elbow terminal prevents short-bend wear and tear on harness and provides quick accessibility. Made in types for supercharged and super-compressed engines to meet idling or full throttle conditions.

THE B. G. CORPORATION

136 WEST 52nd STREET, NEW YORK, N. Y.

CABLE ADDRESS: GOLSTECO, NEW YORK ***CONTRACTORS TO THE UNITED STATES ARMY AND NAVY***

~~Mud~~
~~Sand~~
~~Snow~~
~~Plowed Ground~~
Timber
~~Rolling Ground~~
Fog
~~Cross Winds~~
~~Small Fields~~
Water



Strike out

most of the landing hazards

Less than two years ago, every landing condition on this list meant real risk for the ship and pilot.

Today, you can strike out seven of the ten, if your ship carries Goodyear Airwheels and the new Airwheel roller bearing brake.

These great soft rolling rubber pillows spread out when they touch the ground—and carry you safely through mud, over sand, snow and plowed ground. With Airwheels, you can make downhill or hillside landings—cross-wind or down-wind too.

With Airwheels and Airwheel brakes—you can "stop on a dime." These brakes combine *power, smoothness* and *sure release* in such perfect combination that you can slide the wheels or bring up the tail (depending on landing surface) and still keep complete control.

Think that over, you men who own ships and you men who fly them. Can you afford to be without this protection?

Only Goodyear can give you Airwheel safety. For engineering data, write or wire Aeronautics Department, Goodyear, Akron, Ohio, or Los Angeles, California.

When you buy a new ship specify Goodyear Airwheels

GOODYEAR

EVERYTHING IN RUBBER FOR THE AIRPLANE

TOWLE AIRCRAFT CO., INC.

Another prominent user of **SKF** *Bearings in the Aviation Industry*

Where PERFORMANCE TAKES PREFERENCE over PRICE

PERFORMANCE MAKES SKF THE SELECTED BEARING

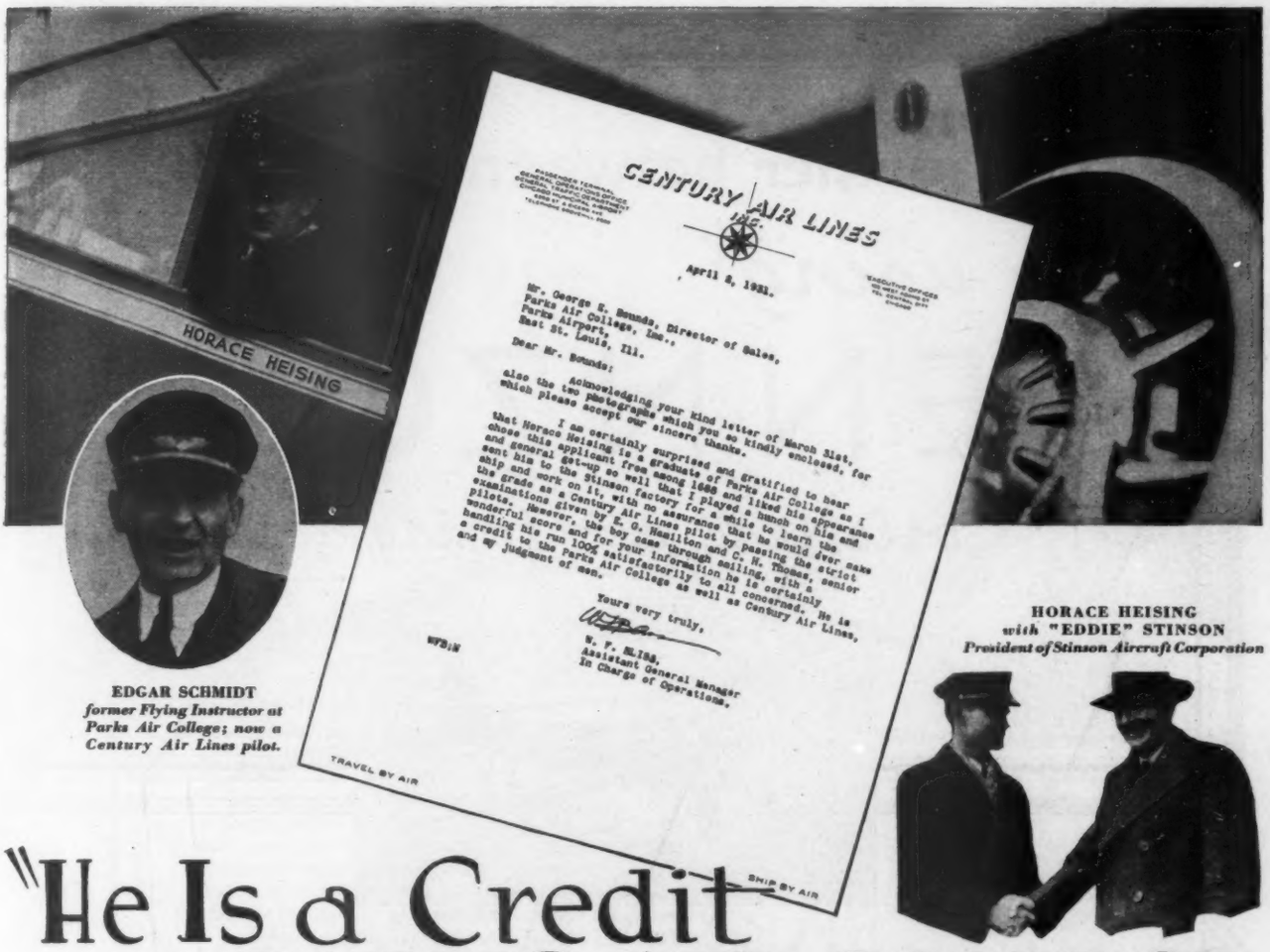
ON the new Towle . . . the first all-metal amphibian built in this country . . . SKF Performance takes preference over Price. "The selection of SKF Self-Aligning Ball Bearings as standard equipment on all hinged control surfaces on the Towle Model TA-3 Amphibian is the result of long experience and tests on bearings of all kinds and types," says the Chief Engineer, and adds, "we have always found them to be entirely satisfactory."

In addition, the twin Packard-Diesels which enable the Towle Amphibian to cruise at 100 m.p.h. with full load . . . or wide open at 124 m.p.h. . . . are also SKF equipped. The certainty of SKF Performance in the air has made SKF *the selected bearing* of 65 manufacturers in the aviation industry.

SKF INDUSTRIES, INC., 40 East 34th Street New York, N. Y.

2687

SKF


HORACE HEISING
CENTURY AIR LINES INC.
April 8, 1931.
Mr. George E. Bounds, Director of Sales,
Parks Air College, Inc.,
Parks Airport,
East St. Louis, Ill.
Dear Mr. Bounds:
Acknowledging your kind letter of March 31st, also the two photographs which you so kindly enclosed, for which please accept our sincere thanks.
I am certainly surprised and gratified to hear that Horace Heising is a graduate of Parks Air College as I choose this applicant from among 1688 and liked his appearance and general get-up so well that I played a hunch on him and sent him to the Stinson factory for a while to learn the ship and work on it, with no assurance that he would ever make the grade as a Century Air Lines pilot by passing the examinations given by E. G. Hamilton and C. H. Thomas, senior pilots. However, the boy came through and, with a wonderful record for 100% satisfactorily to all concerned. He is handling his run 100% satisfactorily to all concerned. He is a credit to Parks Air College as well as Century Air Lines, and my judgment of men.
Yours very truly,
W. F. M.Jr.
Assistant General Manager
In Charge of Operations.
WFM:M
TRAVEL BY AIR
SHIP BY AIR

EDGAR SCHMIDT
former Flying Instructor at Parks Air College; now a Century Air Lines pilot.

HORACE HEISING
with **"EDDIE" STINSON**
President of Stinson Aircraft Corporation

"He Is a Credit to PARKS AIR COLLEGE and to CENTURY AIR LINES"

A THOUSAND WORDS couldn't tell you more than this letter. Here is further proof that the best and biggest places in Aviation are open to Parks graduates. . . . Air-transportation will make greater progress between now and January 1, 1932, than it has made since the World War. More and better opportunities await the trained pilot than ever before. Nothing less than the best in aviation-training should satisfy you. If you've got the right stuff in you, you'll get the right training at Parks. Mail the coupon for full information.

SEND FOR "SKYWARD HO!"

PARKS AIR COLLEGE

WORLD'S LARGEST COMMERCIAL FLYING SCHOOL

PARKS AIRPORT
EAST ST. LOUIS, ILL.

☐ Mechanic's Course
☐ Line Service Master Mechanic's Course

APPROVED BY UNITED STATES DEPARTMENT OF COMMERCE

SECTION 5-AV
☐ Limited Commercial Course
☐ Transport Course

Name _____ Address _____

City _____ State _____ Age _____ Occupation _____

Fly farther between overhauls *by using* PENNZOIL*

Costs less per flying hour

IF you haven't thought of the difference oil can make in the amount of flying time you get out of your plane consider this:

PLANES lubricated with ordinary oils require overhauling every 150 to 250 hours. Planes lubricated with Pennzoil Aircraft Oils are regularly and safely flown 300 to 400 hours without overhauling. **In short, Pennzoil can increase the period between overhauls materially.**

THIS increases flying time and reduces repair costs. Pennzoil gives approximately 15 hours more flying with every refill. These are the reasons why Pennzoil has been adopted by America's great passenger lines and good operators everywhere.

Pennzoil is made from 100% Pennsylvania crude and nothing else. It differs from all other Pennsylvania oils because of the famous Pennzoil process which uses only the heart of the crude — the fraction richest in lubricating efficiency. Sold at most airports from coast to coast.

The PENNZOIL COMPANY: Executive Offices and Refinery: Oil City, Pa.
Division Offices: New York, Chicago, Los Angeles
British-American Oil Co., Ltd., Sole Distributors in Ontario and Quebec, Canada

****It isn't enough to ask for "Pennsylvania oil"***
—to be sure of lowest cost per flying hour, say "PENNZOIL"

35¢ a quart

Slightly higher in the West and Canada

100% PURE PENNSYLVANIA
PENNZOIL
SAFE LUBRICATION

Hear Pennzoil Pete and Andy Sannella's All Star Orchestra over WEAF and 35 other N. B. C. stations Monday evenings, 8:15 Eastern Standard Time.

PERMIT NO. 2—PENNSYLVANIA GRADE CRUDE OIL ASS'N

THE GUARANTEED PENNSYLVANIA 100% Pure Pennsylvania Oil of Supreme Quality

This seal is more than a pledge of 100% Pure Pennsylvania. It is our guarantee to you of highest quality finished Aircraft Oil.

+ + + + + + + ALUMINUM *in Aircraft* + + + + + + +

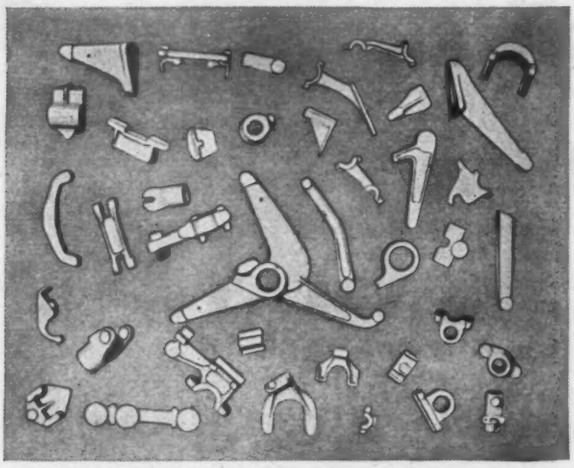


Fig. 35. Aluminum alloy aircraft fittings made from heat treated

Vario[illegible]ngs for the structure, control mechanism, interplan[illegible]other apparatus, are commonly produced as aluminum c[illegible]s, usually in the high strength 195 alloy, and forgings, or [illegible] machined from larger wrought stock. Heat treated sand casting alloys are also employed for such parts as the oleo wheels, spring casin[illegible] shoes, landing gear fittings [illegible] pontoon nose [illegible]eces.

The size and shape of a part and the physical properties desired in it, largely dictate the manner in which it is made. A great many parts now produced as castings might easily be forged, while others might be fabricated in this manner were a few minor changes made in the design. A forging is, of course, stronger; and while the casting may have sufficient strength for the service it is to perform, a forging provides an added factor of safety. The greater strength of the forging may be utilized in further weight [illegible]ductions by decreasing section thickness. Because of the sm[illegible]

68

This paragraph tells how to add safety and, at the same time, shrink dead-load.

The book is chockfull of data that show how many parts may be designed to combine safety, lightness and strength.

SEND 50c for it

A Book for Aircraft Engineers, Builders, Operators and Maintenance Men

There are 54 engine parts that may be made lighter and stronger when made of Alcoa Aluminum. In the construction and assembly of wings, fuselages, hulls and pontoons, Alcoa Aluminum can lighten the dead-load, increase the pay-load.

There is a 29-page chapter on corrosion with numerous photographs and tables, showing specifically how corrosion may be prevented.

All the facts have been compiled during the last 14 years in our work with the U. S. Bureau of Standards, U. S. Army Air Corps, U. S. Navy Bureau of Aeronautics, The Naval Aircraft Factory, and with airplane manufacturers, operators, pilots and mechanics.

Don't you want the book *NOW*? Send us the coupon. U. S. Postage Stamps accepted. ALUMINUM COMPANY of AMERICA; 2482 Oliver Building, PITTSBURGH, PENNSYLVANIA.

Aluminum Company of America;
2482 Oliver Bldg., Pittsburgh, Pa.
Please send me "Aluminum in Aircraft."

Name_____

Street and Number_____

City_____ State_____

Name of Company_____

Position_____

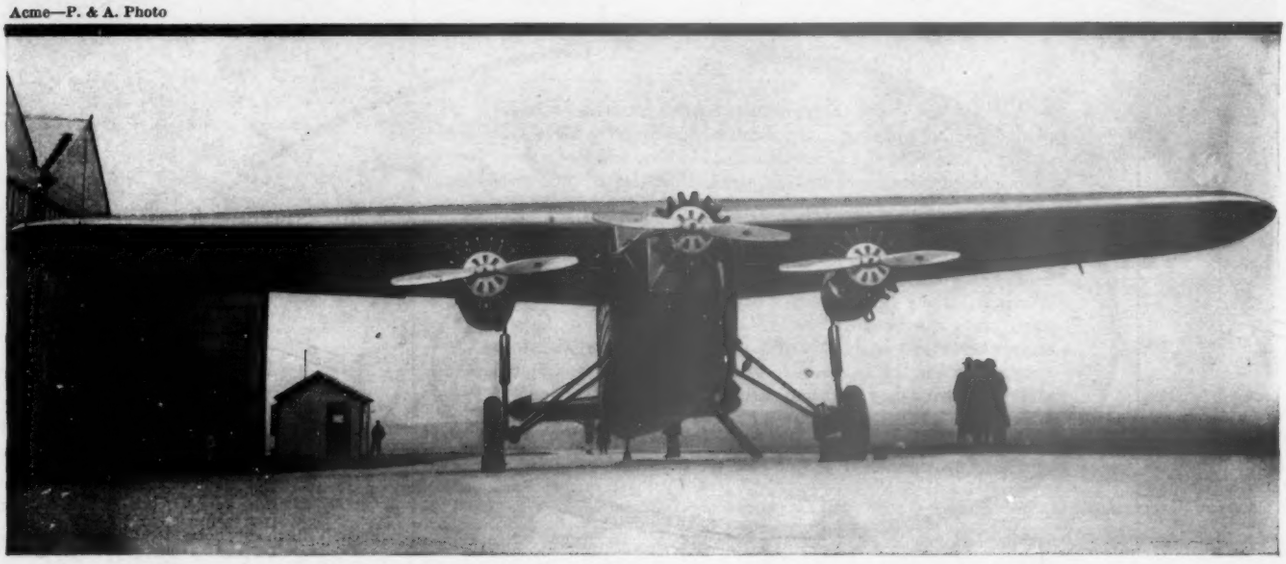
ALCOA ALUMINUM
The one metal that flies best

"WASP" ENGINES *fly from*

HOLLAND TO JAVA

with the World's Oldest Air Transport Company

Acme—P. & A. Photo



This Fokker transport, powered with three Pratt & Whitney "Wasp" engines, is used on the famous K. L. M. line to carry passengers, mail and express between Amsterdam, Holland and Batavia, Java, Dutch East Indies.

Spanning the 14,350 kilometers (some 8,897 miles) that separate Holland from Java, the planes of the Royal Dutch Air Lines (K. L. M.) make the trip in ten to twelve days. By steamer the same trip requires a month.

This picturesque air route sweeps from the Netherlands across Germany, Austria and Jugo-Slavia to Athens. Thence it crosses Turkey, Iraq and Persia to India, and so to Java, via Siam, the Malay States and Sumatra. Nearly 9,000 miles, over mountains, jungles, plains and sea. Pratt & Whitney "Wasp" engines were selected to power the Dutch-built Fokker planes because engine dependability and performance are vital —every mile of the way.

Here, as on approximately ninety per cent of the important, regularly scheduled air transport lines of this country, Pratt & Whitney engines are contributing the sort of reliability which has its only source in experienced craftsmanship.

Wasp* & Hornet* *Engines*

*REGISTERED TRADE-MARK

THE
PRATT & WHITNEY AIRCRAFT CO.
EAST HARTFORD . . CONNECTICUT, U. S. A.

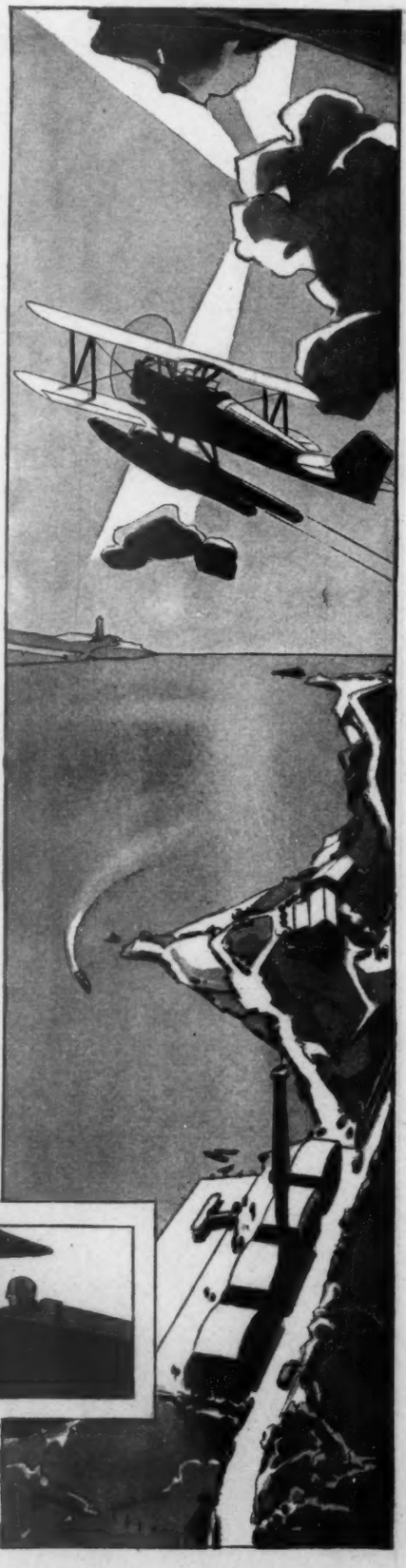
Division of United Aircraft & Transport Corporation

Manufactured in Canada by Canadian Pratt & Whitney Aircraft Co., Ltd., Longueuil, Quebec; in Continental Europe by Bavarian Motor Works, Munich; and in Japan by Nakajima Aircraft Works, Tokyo.

RAIN *or* SHINE

ANYTIME

Equipped with the new convertible cabin enclosure feature that changes its roomy cockpit to a closed cabin in but a few minutes, no sudden shift of the weather need stay the flight of The FLEET. In commercial flying schools The FLEET equipped with the new cabin enclosure serves the purpose of two planes in giving instruction to students in both open cockpit and cabin types, as required by the Department of Commerce. Another instance of FLEET economy. ● This freedom from weather restrictions is of equal importance to private owners whose preference for The FLEET is shown by the constantly increasing enrollment in FLEET equipped schools, of students who wish to train in the plane they eventually will buy ● In a demonstration flight The FLEET will prove the superb performance, maneuverability, and low air-hour cost, that have made it the standard of its class throughout the Western Hemisphere ... the most popular light plane for sport flying and private ownership.



THE FLEET

FLEET AIRCRAFT INC. • BUFFALO, NEW YORK

AMERICAN AIRPLANE & ENGINE CORPORATION

has been formed by

THE AVIATION CORPORATION

to carry on the business of

FAIRCHILD AIRPLANE MANUFACTURING CORPORATION

and

FAIRCHILD ENGINE CORPORATION

at

Farmingdale, New York

AMERICAN AIRPLANE & ENGINE CORPORATION

under the direct management of

COLONEL V. E. CLARK

will manufacture

PILGRIM AIRPLANES

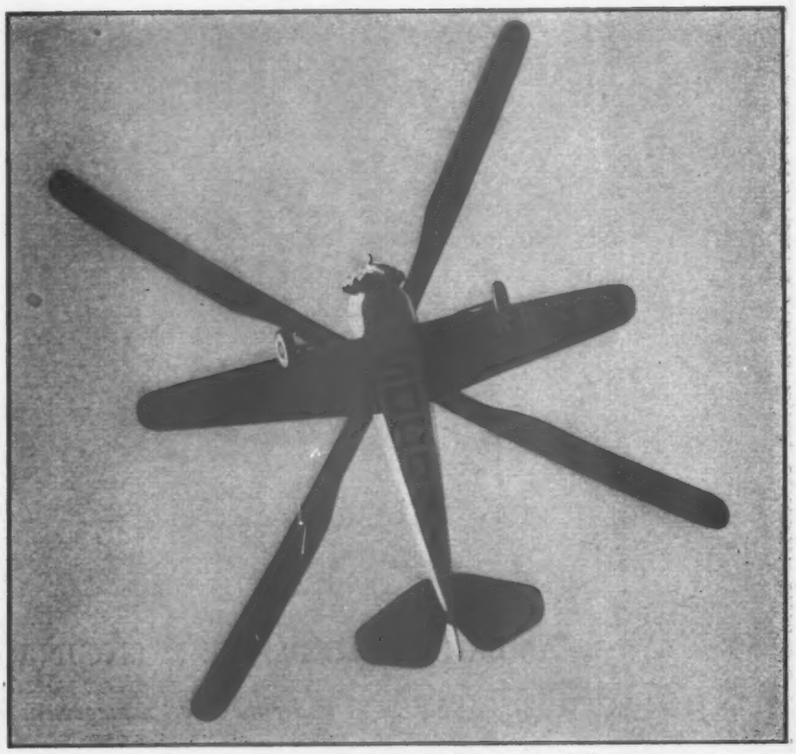
and

RANGER ENGINES

at

Farmingdale, New York

Looking up at the Socony Test Plane which has a range of flying speeds from 20 m.p.h. to 120 m.p.h. It can descend vertically at less than half the speed of a man in a parachute.



AERIAL RESEARCH "LABORATORY"

. . . a new Socony development

SUPPLEMENTING the work of Socony Research Laboratories, the Standard Oil Company of New York is extending its "field" work to include research on aviation products. An Autogiro—the latest development on aircraft—has been purchased for this purpose.

In the course of its work, this plane—the Socony Test Plane—is fueled with Socony Aviation Gasoline and lubricated with the new Socony Motor Oil. These and other Socony aircraft products, because of their economical and dependable performance, are the most popular in New York and New England today.

SOCONY

Aviation Gasoline New Socony Motor Oil

STANDARD OIL COMPANY OF NEW YORK

NIMBLE FOR SPORTSMEN

SIMPLE FOR STUDENTS!

TRAVEL AIR

SPORT-TRAINER

Racy and rugged for sportsmen, sturdy and stable for students, the sleekly stream-lined new TRAVEL AIR *Sport-Trainer* is a striking example of the benefits you gain in a ship built by the biggest builders of many types of planes. ● For this latest TRAVEL AIR model offers any number of new developments in stability, handling and servicing ease, and smart, sporty looks, which can be effected only when an organization builds for the whole field. ● You'll like the *Sport-Trainer's* clean-cut lines, its smooth, sure, speed of over 100 miles an hour, and its cruising range of better than 500 miles. ● For this sturdy ship is so nimble getting off the ground or floating back, so stable in the air, that it's indeed the sportiest of ships to fly. ● Powered with the Warner 110 h. p. engine, equipped with a remarkable development in full tread, shock-absorbing landing gear plus brakes, the *Sport-Trainer* is designed in every detail to make flying not only simple but inexpensive. See this TRAVEL AIR at your Curtiss-Wright dealer's now. Compare its value! Fly it on your own!

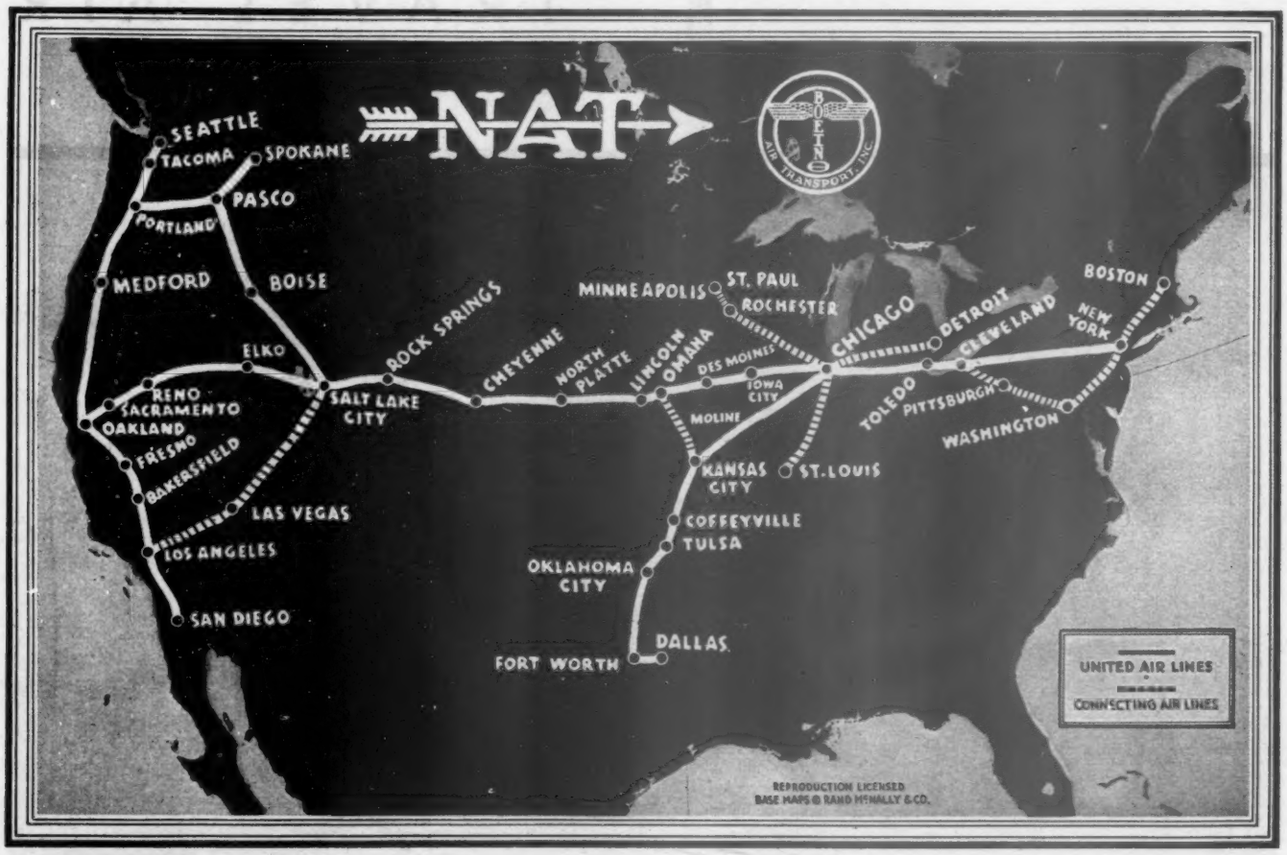
CURTISS-WRIGHT

AIRPLANE COMPANY

ROBERTSON, MISSOURI

FACTORIES: WICHITA, KAN. ROBERTSON, MO.

28 HOURS FROM SAN FRANCISCO TO NEW YORK



With STANAVO the planes of N. A. T. and Boeing span the continent daily

Leave San Francisco in a Boeing Air Transport plane at noon-time, change to a National Air Transport plane at Chicago the following noon, arrive in New York in time for the theatre that night. Just twenty-eight hours of night and day flying —and the return trip is made in thirty-one hours.

Coast-to-coast on the fastest trains takes 77½ hours. Now by air the trip is made in *one third* the time. This first continuous air passenger route is the contribution of United Airlines to the progress of air travel in America.

Boeing—flying the most hazardous and difficult part of the trip—has adopted Stanavo Aviation Gasoline for exclusive use in all of its planes. Every engine on every N. A. T. and Boeing plane flying the coast-to-coast route is lubricated with Stanavo Aviation Engine Oil.

STANAVO
AVIATION ENGINE OIL AND GASOLINE

One Brand—STANAVO. One Quality—the Highest Throughout the World

STANAVO SPECIFICATION BOARD, Inc.

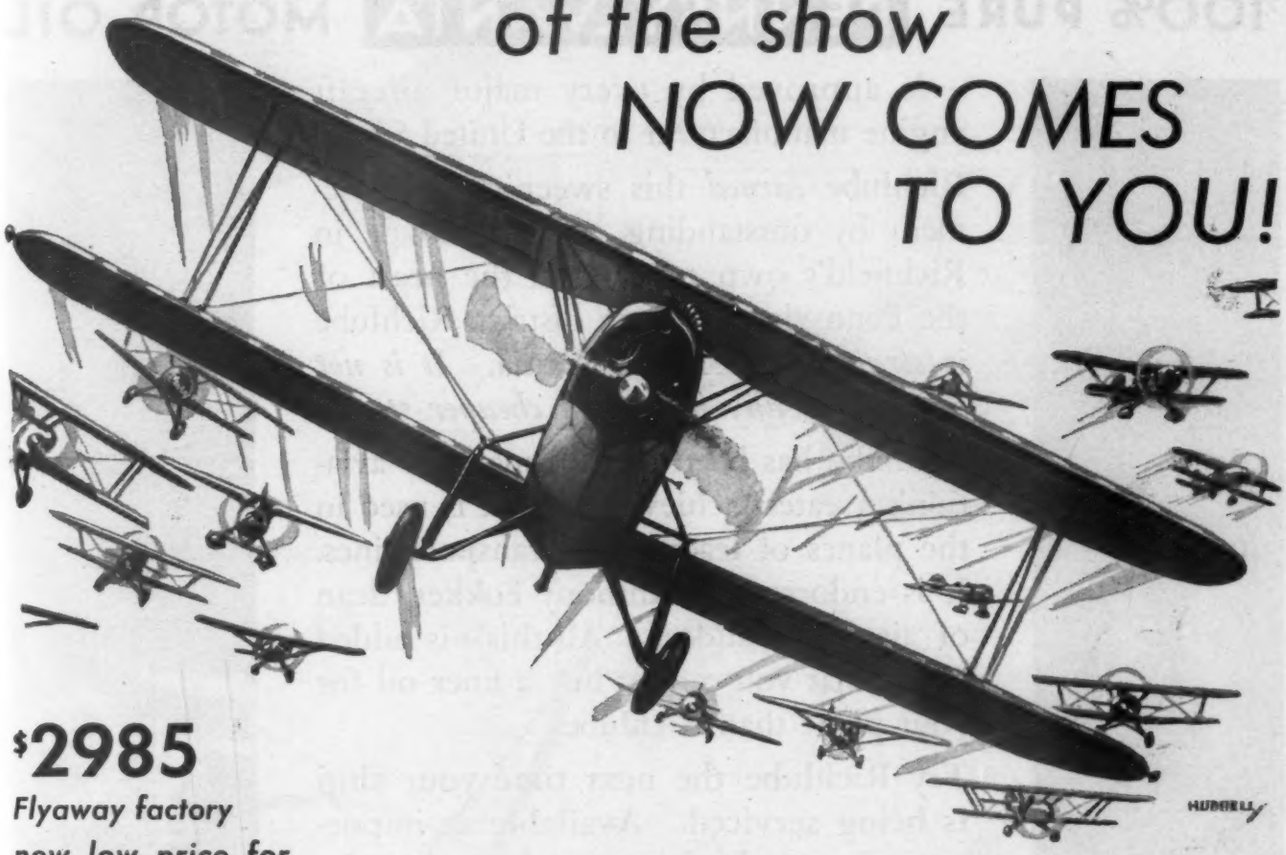
Organized and Maintained by

Standard Oil Co. of California
225 Bush St., San Francisco

Standard Oil Company (Indiana)
910 S. Michigan Ave., Chicago

Standard Oil Co. of New Jersey
26 Broadway, New York City

THE BIG NEWS of the show NOW COMES TO YOU!



$2985

Flyaway factory new low price for

GREAT LAKES SPORT TRAINER

The Sport Trainer is now made with an upright engine, shown above, or an inverted engine as pictured below. It has a high speed of 110 miles per hour, a cruising speed of 90 miles an hour, and a cruising range of 370 miles in 4.10 hours. Manufactured under U. S. Department of Commerce approved type certificates, Nos. 228 and 354.

EXPRESSING the keynote of advanced aviation . . . ahead of its field in value and performance . . . the Great Lakes Sport Trainer captured new interest and enthusiasm throughout the entire National Show at Detroit.

There is new beauty, enhanced stability and greater visibility in the Sport Trainer this year. For this easy handling craft—always a remarkable plane in maneuverability and responsiveness—possesses even greater stamina by the refinements and improvements incorporated in the 1931 models.

Be sure you know why the Sport Trainer by Great Lakes is the outstanding value of the year. Write today for the descriptive folder and prices. *The Great Lakes dealership is still available in many important centers.*

GREAT LAKES AIRCRAFT CORPORATION — **CLEVELAND**

Contractors to the United States Army and Navy

RICHLUBE

100% PURE PENNSYLVANIA MOTOR OIL

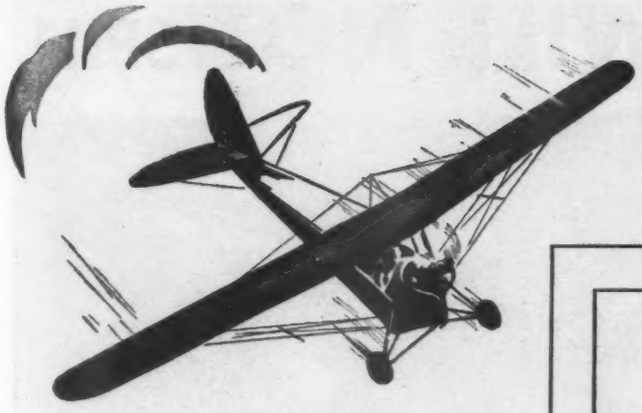
—is approved by every major aircraft engine manufacturer in the United States!

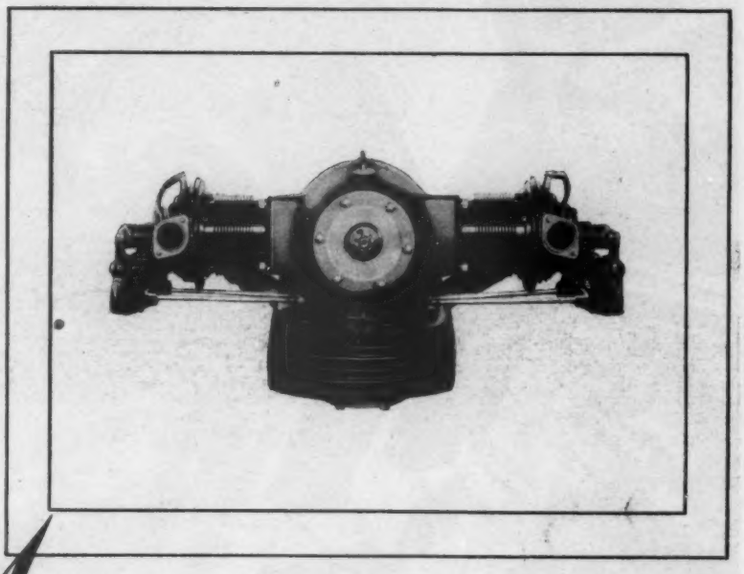
Richlube *earned* this sweeping endorsement by outstanding quality. Made in Richfield's own refinery in the heart of the Pennsylvania crude district, Richlube is *straight-run* Pennsylvania. *It is not blended in any way with cheaper stocks!*

Richlube has been used in many of aviation's greatest achievements. It is used in the planes of leading air transport lines. It is endorsed by Anthony Fokker, dean of airplane builders. All this—is added proof that you cannot buy a finer oil for your plane than Richlube.

Try Richlube the next time your ship is being serviced. Available at important airports both east and west of the Mississippi River.

RICHFIELD OIL COMPANY
LOS ANGELES · NEW YORK CITY





AGAIN *Aeronca*

COMES TO GOVRO–NELSON

FOR the Aeronca Duplex C-3, a sturdy motor of 40 horsepower was demanded. At the shops of Govro-Nelson where 200 units of the Aeronca E-107A have already been built, the new engine, the E-113, is now in production.

Aeronca's choice of Govro-Nelson, based on a year's intense experience with the Govro-Nelson built E-107A, clearly illustrates correct design principles, and thorough manufacture.

Definitely, it proves that products of the Govro-Nelson shops are built to give the superior performance that is demanded in the air.

Govro-Nelson facilities are keyed to the demands of the aviation industry. You, too, can use them to good advantage. Write us, without obligation, concerning any design or manufacturing problem.

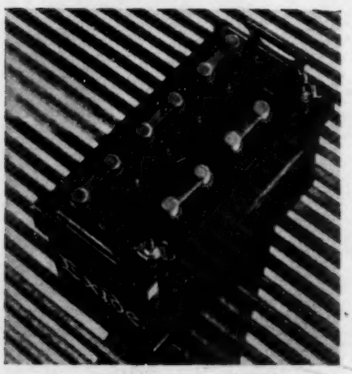
THE GOVRO-NELSON COMPANY

1931 ANTOINETTE DETROIT

CRAFTSMEN TO THE AVIATION INDUSTRY

THE ELECTROLYTE WILL NOT SPILL

You may look at Chicago like this and yet be battery-safe, when there's an Exide in your cockpit.



This Exide Aircraft Battery was made to fly. It's light-weight, compact, safe.

Exide Aircraft Batteries are so designed that even loops will not spill the electrolyte

THE Exide Battery is as dependable as it is safe. It helps make radio communication certain in fog and storm. It furnishes reliable current for landing, navigation and instrument lights—starting and ignition.

Exides have already proved their worth over millions of miles of sky lanes. Just ask your flying friends about Exide reliability . . . its compactness . . . its light weight.

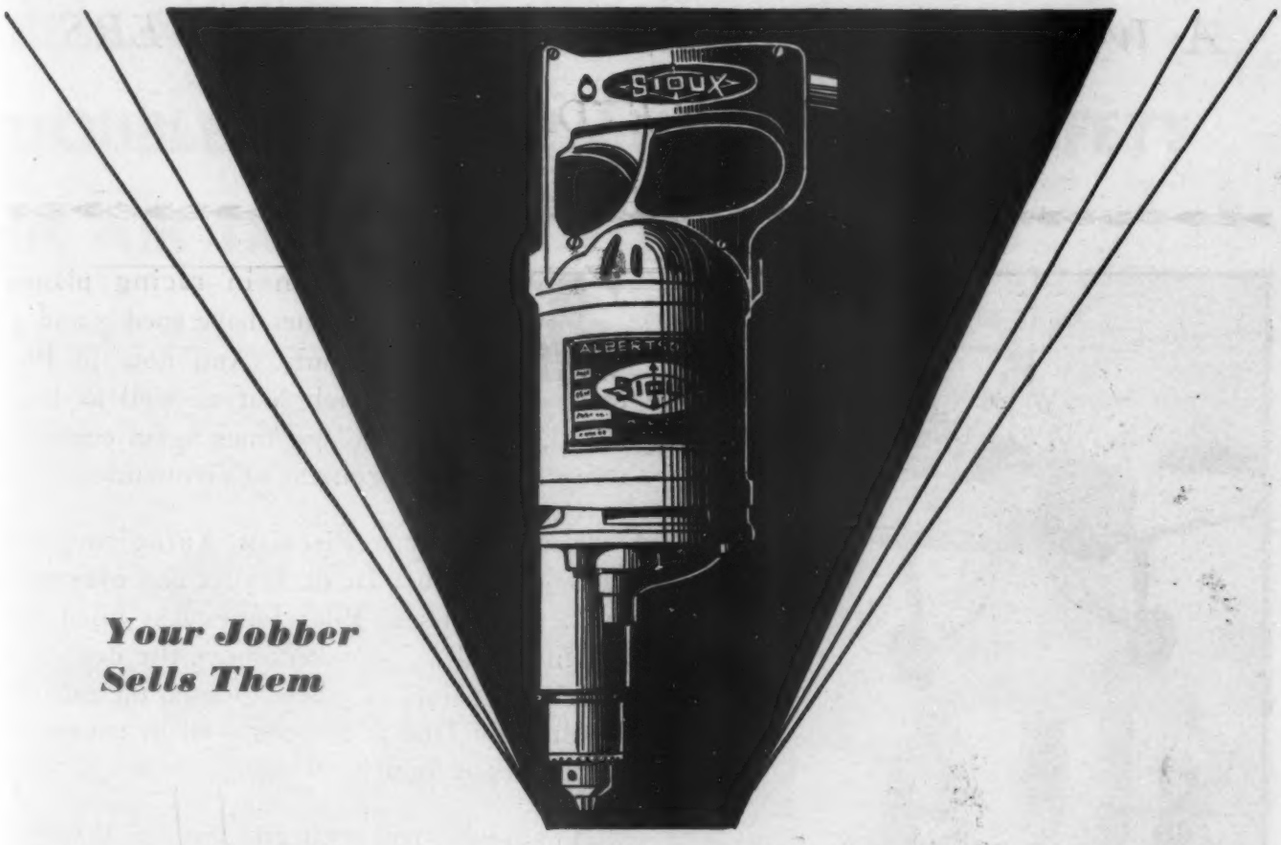
Write today for further information about the many types of Exide Aircraft Batteries. One-seater "mono" or transcontinental air liner—there's an Exide to fill the bill.

Exide
AIRCRAFT BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia

THE WORLD'S LARGEST MANUFACTURERS OF STORAGE BATTERIES FOR EVERY PURPOSE

Exide Batteries of Canada, Limited, Toronto



Your Jobber Sells Them

STANDARD THE SIOUX WORLD OVER

PORTABLE ELECTRIC DRILLS

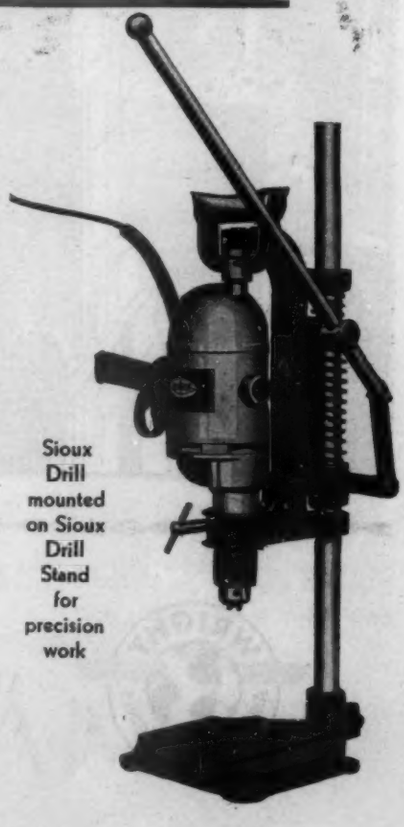
SIOUX Drills have established a reputation for accuracy, dependability and sturdiness. They have introduced an entirely new conception of efficient, unfailing and lasting service.

Greater power than ever before known in drills of their rated capacity. Smooth, quiet operation assured by helical-cut, heat-treated, chrome-nickel steel gears. Ball bearings throughout motor and on chuck spindle. Cool-running—a new correctly designed system of ventilation prevents over-heating. Great strength with light weight—the drill body is a hard, smooth-surfaced aluminum die casting.

Made in ¾, ⅝, ½, 5/16 and ¼ inch Heavy Duty. Also ½ and ¼ inch Standard and a new low priced ¼ inch Light Duty (No. 1490).

Sioux Bench Drill Stands are available for all models of Sioux Drills. Also Post and Floor Drill Stands for ½, ⅝ and ¾ inch Sioux Drills.

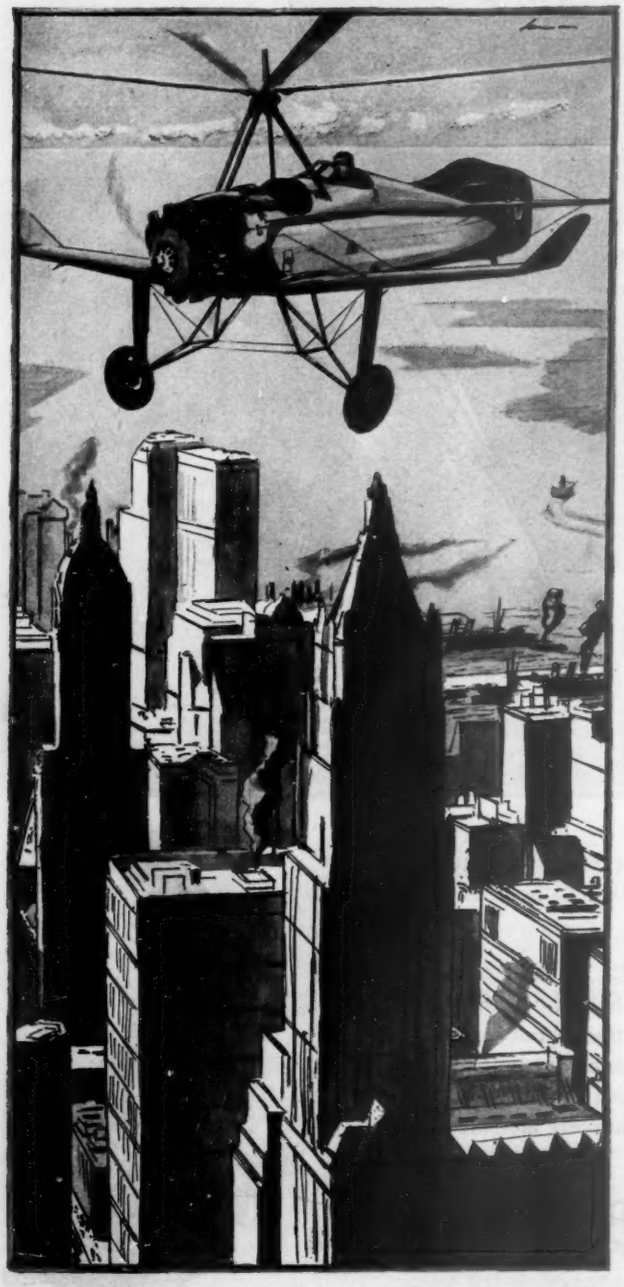
Only with Sioux Tools can you get the Sioux guarantee.



Sioux Drill mounted on Sioux Drill Stand for precision work

ALBERTSON & CO. INC.,
SIOUX CITY, IOWA. U.S.A.

A WRIGHT-POWERED AUTOGIRO HOVERS OVER THE ILE DE FRANCE!



TIME and again in racing planes Wright engines have sped 3 and 4 miles a minute. And now in Pitcairn Autogiros, which loaf as well as leap ahead, "Whirlwinds" are once again contributing to the advancement of aeronautics.

For recently a Pitcairn Autogiro gave chase to the liner Ile de France and overtook it 50 miles at sea. Pilot James Ray idled his "Whirlwind"... hovered above the deck ... lowered a parcel ... then zoomed up and off heading for land at a speed well in excess of 100 miles an hour!

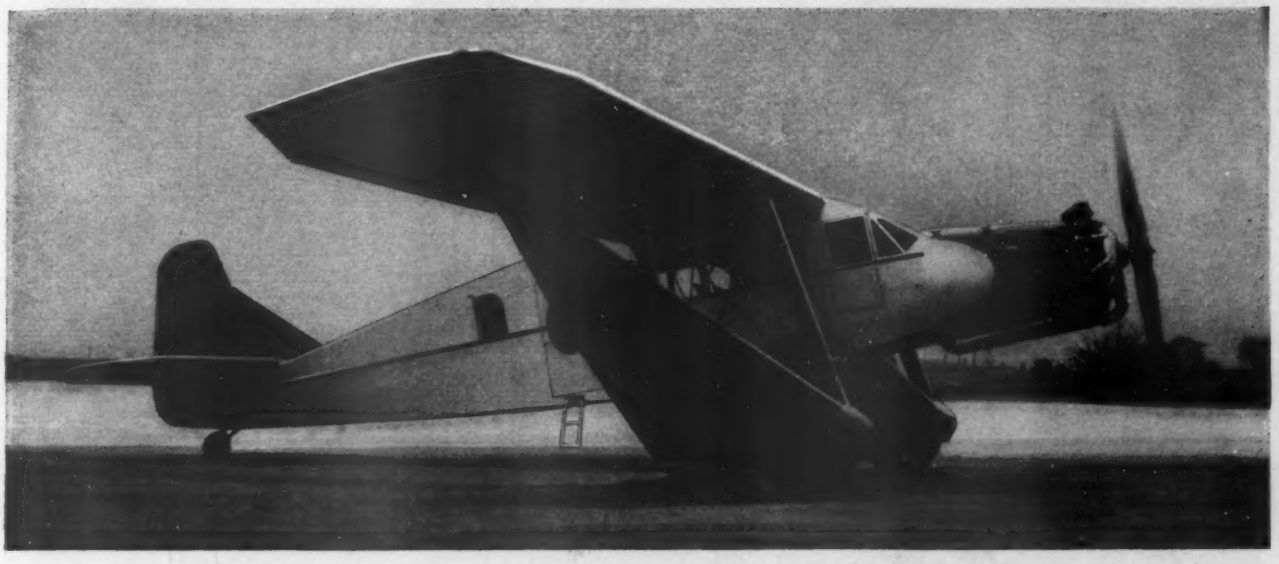
That's what you get in an engine by Wright. Power enough to win records for speed, yet power so wide in range, so smoothly controlled, that it holds these nimble, gull-like planes to the pace of a passenger liner.

Pilots who fly Wright engines know this by test. Operators know it by service and maintenance checks. Passengers who ride behind them know it by hundreds of thousands of miles of swift, smooth travel.

And manufacturers of the Autogiro selected engines by Wright because they know what "Whirlwinds" can do. For in flights of more than 10,000 miles Autogiros have displayed an alertness undreamed of before ... almost standing still aloft ... to prove that it's easy to fly with Wright!

WRIGHT
AERONAUTICAL CORPORATION
PATERSON, NEW JERSEY
A DIVISION OF CURTISS-WRIGHT CORPORATION

BELLANCAS WITH SINGLE ENGINES DOUBLE EFFICIENCY AND ASSURE SAFETY IN AIR TRANSPORTATION . . . . .



The AIRBUS—

12-16 Place: Pilot with 11 Passengers and 1,075 lbs. of Baggage and Cargo, or 15 Passengers and 450 lbs. of Baggage. Range, 570-700 Miles. Cruising Speed, 120 m.p.h.

PAYLOAD: twice that of other single-engined transport planes of similar horsepower. Consists of 15 passengers and their baggage or 11 passengers and 1,075 lbs. of baggage, freight and mail. Can also be arranged as a private owner's cruiser, with every luxury of appointment.

OPERATING COST: half that of multi-engined airplanes of similar load capacity. The single Cyclone or Hornet engine is economical to operate and utterly reliable. Fuel for 570–700 miles, according to payload required, is provided.

SAFETY: due to that perfection of flying qualities, control, and quiet comfort which only the single-engined airplane provides, as the history of aviation has proved.

THE RESULT: earning capacity far beyond that of any aircraft as yet produced.

The PACEMAKER—6-Place Monoplane with Whirlwind 9—300 h.p. Engine

The same excellent characteristics are embodied in the Pacemaker and the Wasp-engined Skyrocket, both 6-place single-engined ships which are known the world over for their extraordinary performance and have earned for Bellanca an unparalleled record for safety and endurance.

All Bellanca Aircraft Manufactured under Department of Commerce Approved Type Certificates

Write for Literature and Further Information

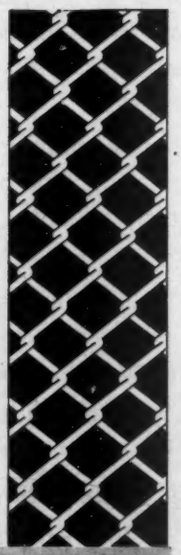
BELLANCA AIRCRAFT CORPORATION

New Castle, Delaware **Chrysler Building, New York**

Bellanca Aircraft of Canada, Ltd., Montreal

BELLANCA

They Deserve Every PROTECTION



An Anchor Fence doing crowd-control duty during the landing of Coste's plane.

"CARRY ON" is the Air Mail Pilots' slogan. Fog, rain or storm does not daunt them.

Safety devices and improved airplanes make for their safety in the air.

However, safety measures are just as important on the landing field. Only a clear field is a safe field. Keep your field "clear." Bar crowds from the flying area with an Anchor Fence. An Anchor Fence will reduce the risk of accidents by giving the Pilot every available foot of area the field affords.

A landing field is the Pilots' haven of refuge. Make it safe. They deserve every protection.

The local Anchor representative will be glad to explain our complete Airport Fencing service. Just phone or write him to call. Or, send for a catalog.

ANCHOR POST FENCE COMPANY
Eastern Ave. and Kane St., Baltimore, Md.

Albany Boston Buffalo Charlotte Chicago Cincinnati Cleveland Detroit Hartford Houston Indianapolis Los Angeles Mineola, L.I. New York Philadelphia Pittsburgh St. Louis San Francisco Shreveport

Representatives in all principal cities. Consult your local classified directory.

ANCHOR FENCES

The Famous
SWITLIK
SAFETY CHUTES
Now Only
$300
FOR WHITE SILK

and

$240
FOR PONGEE SILK

Pilots:—Here is the greatest value in Aviation today. A proved superior SWITLIK SAFETY CHUTE (with the famous patented combination pack cover and pilot chute) at a saving of $75.00. Here is the chute that is smaller, lighter, more compact, perfectly smooth, really comfortable to wear, and of proved quicker opening—at a lower price than you would pay for an ordinary chute. Every SWITLIK CHUTE is drop tested and approved with A: T. C. Wire or write at once.

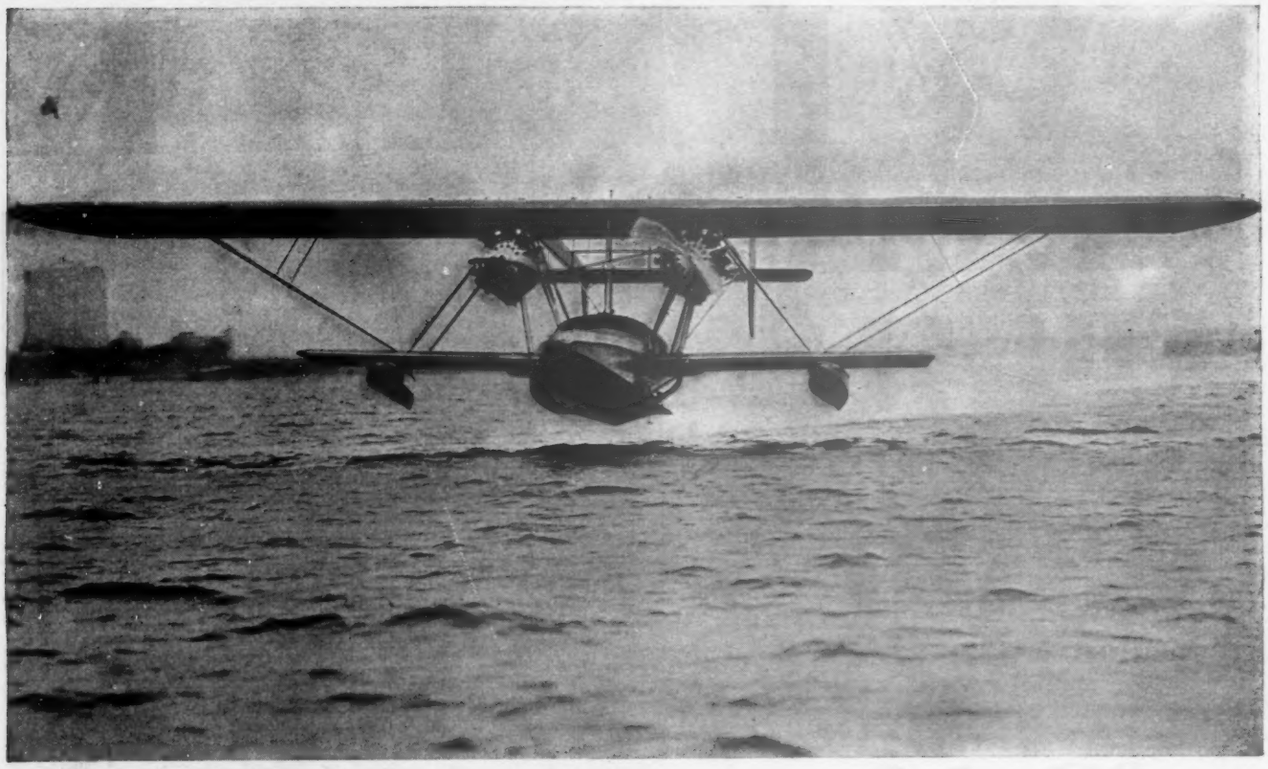
WE OFFER RELIABLE DEALERS
A SPLENDID PROPOSITION
IN EXCLUSIVE TERRITORY

Department of Commerce Officials—Air Mail Pilots and Famous Flyers use Switlik Chutes

SWITLIK PARACHUTE & EQUIPMENT CO.
BROAD & DYE STREETS TRENTON, N. J.

WESTERN MANAGER—BERT WHITE—1223 AIRWAY—GRAND CENTRAL AIR TERMINAL—GLENDALE, CALIF.

TEN THOUSAND TEST FLIGHTS



IN THE EVOLUTION OF THE *SIKORSKY S-38*

Over a period of two years, pilots of the Sikorsky S-38 have cooperated with the engineering department of the Sikorsky Aviation Corporation by suggesting refinements of detail and improvements of design, making for greater safety, efficiency and passenger comfort in actual operation. Thus the S-38 has had more than 10,000 practical "test flights" under exacting field conditions. Engineers and pilots of Pan American Airways, which operates a fleet of Sikorsky Amphibions in the West Indies, Central and South America, have made many valuable suggestions, ninety-two of which have been adopted. These valuable improvements are now incorporated in the 1931 model S-38, and most of them are found in other Sikorsky Amphibions —the 5-place S-39, the 16-passenger S-41 and the new 40-passenger S-40.

Capt. Boris Sergievsky, who has established several world's records in Sikorsky Amphibions

A few of the improvements suggested by Pan American operation are:

Rubber walk-way on wing replaced by quartz

Stanchion posts of monel metal to prevent corrosion

Hydraulic brakes

Gasoline capacity increased to 330 gallons

Control wires in cockpit covered

Master ignition switch installed

Engine nose cowlings split for easy removal

Navy towing attachment installed in addition to present system

Instrument wiring changed to prevent compass deviation

Additional steps installed on landing gear

Overhead air intake with scoop installed

Powered with two 420 H. P. Wasp engines, the S-38 flies ten persons at a cruising speed of 110 miles per hour. Equally adaptable to land or water operation. An exceptionally high type of amphibion airplane for executive transport. Sikorsky Aviation Corporation, Bridgeport, Connecticut. Division of United Aircraft & Transport Corporation.

WORLD'S RECORD FOR SPEED WITH LOAD

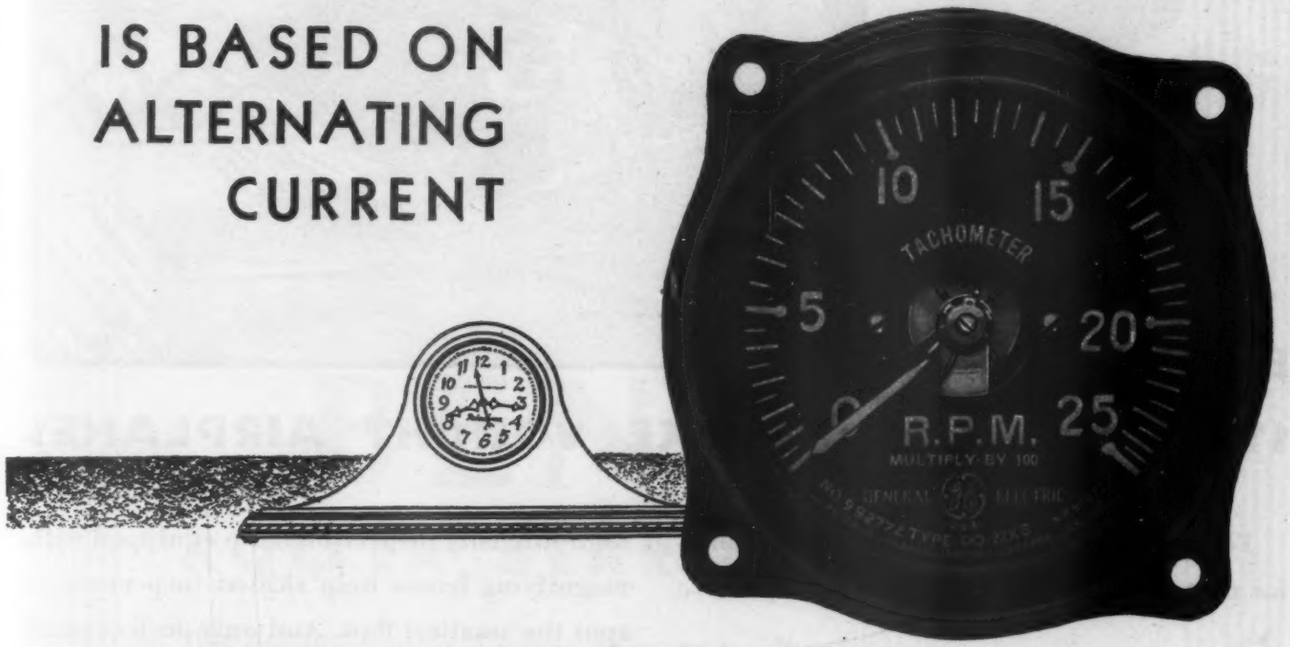
SIKORSKY AMPHIBION

WORLD'S RECORD FOR ALTITUDE WITH LOAD

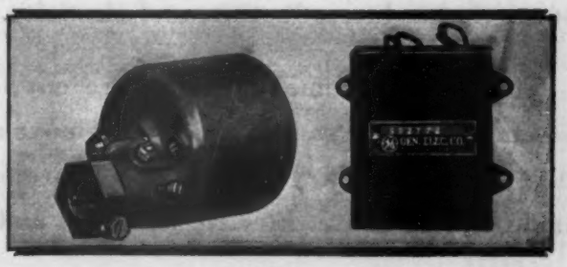
ACCURACY IN THE GENERAL ELECTRIC TACHOMETER

... like accuracy in a synchronous electric clock ...

IS BASED ON ALTERNATING CURRENT



THE indications of the General Electric tachometer for aircraft engines depend on the frequency of the alternating current produced by a small generator. This generator has no commutator and no brushes; it replaces the conventional tachometer drive shaft on the engine and produces a pulsating current that is always in synchronism with the speed of the engine. The indicating instrument measures the frequency of the pulsations in terms of rpm., through the medium of a small transformer, so that fluctuations in voltage do not affect its accuracy. Let us send you complete information. Address General Electric Company, Schenectady, New York.



GENERAL ELECTRIC

AËRONAUTIC EQUIPMENT

700-10

SPECIALISTS IN NEW YORK, WASHINGTON, DAYTON, AND LOS ANGELES

BUILDING STAMINA INTO CHANCE VOUGHT AIRPLANES

To this inspection table comes every tubular part—and only perfect units ever pass it.

Welded into the engine mount and fuselage of every Chance Vought airplane are dozens of pieces of tubular steel. Rigid specifications fix the formula for the material. Careful inspection and tests of stock as it is received make certain that it meets requirements in strength, hardness, ductility and elasticity.

Then, when frame members are cut for assembling, after sand blasting to remove all dirt and grease, they pass to the inspection table shown above. Electric spinning and a high intensity inspection lamp equipped with magnifying lenses help skilled inspectors to spot the smallest flaw. And only perfect parts pass on.

There you have one of the basic reasons why Vought planes stand up in the rigorous service of the Navy and the Marine Corps. Launched from catapults . . . landed on surging steel decks . . . halted by relentless arresting gear . . . these airplanes, built in the modern Vought plant at East Hartford, thrive on hard service. Chance Vought Corporation, East Hartford, Connecticut. Division of United Aircraft & Transport Corporation.

CHANCE VOUGHT CORPORATION

BENDIX

ROLLER BEARING WHEEL

This development is a major advance in effective ground handling —Bendix Airplane Wheels equipped with roller bearings.

The advantages are definite and important—

Brakes and brake drums are concentric—permanently.

Pack the bearings—no attention or maintenance expense for months.

Reduce take-off run up to 10 per cent.

These units range from 6 inch brakes for power gliders to 26 inch brakes for 15 ton transport planes. Built to U. S. Army Air Corps, U. S. Navy, S. A. E. and Tire and Rim Association standards.

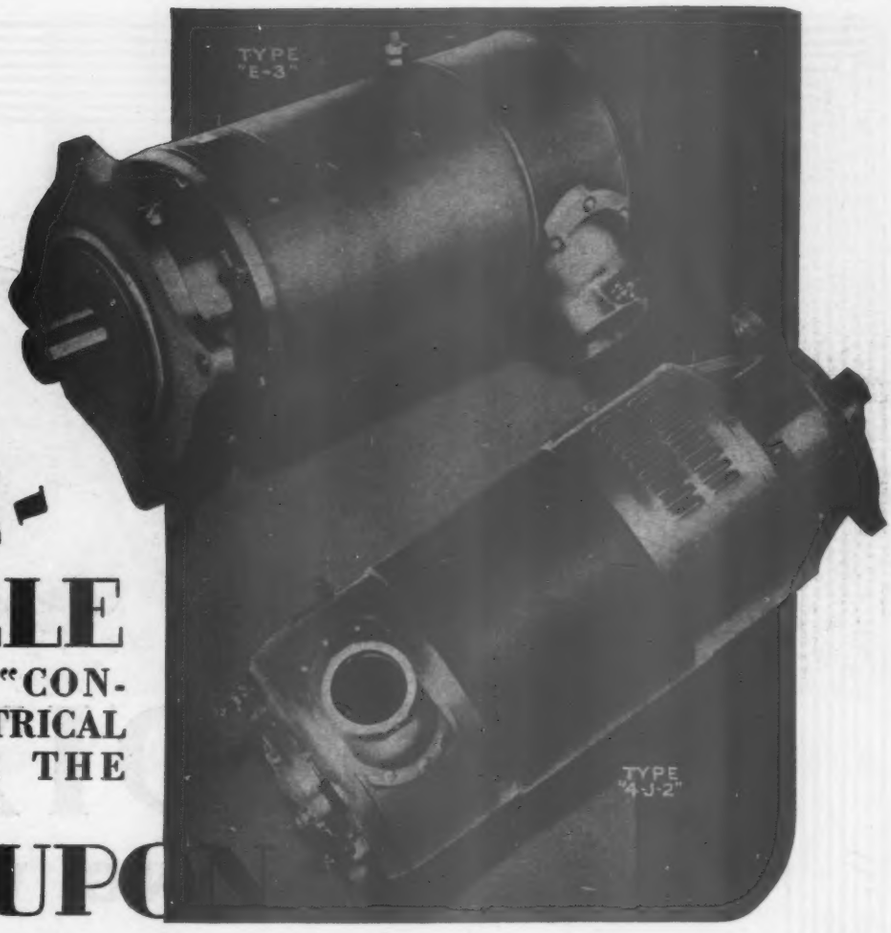
BENDIX BRAKE COMPANY
SOUTH BEND, INDIANA
(Subsidiary of Bendix Aviation Corporation)

BENDIX (4) BRAKES

FOR SAFETY

FULLY PROTECTED BY PATENTS AND APPLICATIONS IN U. S. AND ABROAD

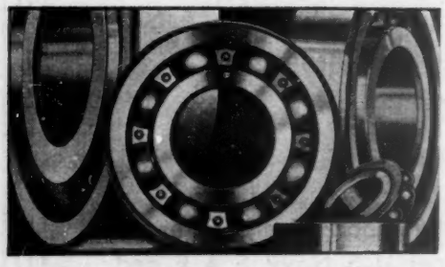
Air Mail Saves Time



LEECE-NEVILLE

PIONEERS IN "CONTROLLED ELECTRICAL ENERGY FOR THE AIRPLANE"

RELY UPON PRECISION BEARINGS



The Leece-Neville Type "E-3" Generator (above) is a single-voltage airplane unit for the usual low-voltage requirements. Type "4-J-2" is a double-voltage unit furnishing both the low voltage and a high voltage for radio. Both types have NORMA-HOFFMANN Bearings at drive end, commutator end, and spline shaft.

In 1920, the Leece-Neville Co. of Cleveland, Ohio—having pioneered in the development of electrical equipment for motor cars and trucks—turned its skill and experience to the problems of electrical equipment for the airplane. And it was but natural that, in this new field, its engineers should incorporate the time-tested dependability of NORMA-HOFFMANN Precision Bearings. Where failure would be most costly—where safety is paramount—PRECISION contributes another vital element in the over-all safety factor of both plane and equipment.

**Send for the NORMA-HOFFMANN Catalogs.
Let our engineers aid you.**

"NORMA-HOFFMANN"

PRECISION BEARINGS

BALL, ROLLER AND THRUST

NORMA-HOFFMANN BEARINGS CORPORATION STAMFORD, CONN., U.S.A.

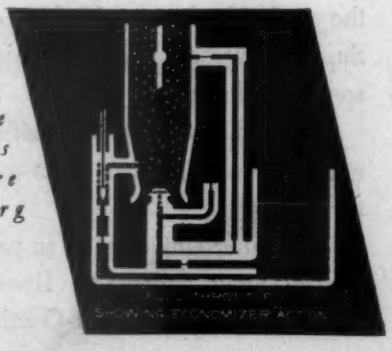
POWER
AT high ALTITUDES

Thanks to the *mixture control* on all Stromberg Aircraft Carburetors, power at high altitudes is no longer a thing unattainable.

This mixture control, operated handily from the dash board, enables the pilot to compensate fully for the change in fuel mixture that takes place as the plane climbs higher. With this controlled increase or decrease in the amount of fuel entering the carburetor, naturally the engine's power is not cut down in proportion to atmospheric density.

Solving this problem is but one of the ways Stromberg engineers have aided in the development of aircraft engines. Theirs is an experience of 22 years. Perhaps they can help you with your own carburetion problems. Inquiries are invited.

Over 95 per cent of the Aircraft engines being built in the United States today are Stromberg equipped.



STROMBERG CARBURETORS

BENDIX STROMBERG CARBURETOR COMPANY

«SUBSIDIARY OF BENDIX AVIAITON CORPORATION»

701 BENDIX DRIVE • SOUTH BEND, INDIANA

by the feeder line

MORE feeder lines are starting in operation this spring than ever before. For there are real possibilities in them and in charter and taxi work at your airport, provided a wise choice is made of planes.

And it has been proved in cold, black figures that the profitable ship for this kind of work is the Fokker Super-Universal. It is economical to operate, sturdy, speedy and durable.

Powered by a Pratt & Whitney 425 h.p. "Wasp" engine; six passenger seats and baggage or lavatory room.

The Super-Universal is in profitable use by many of the most successful lines, such as Western Canadian Airways, Mid-Continent Airways, Dixie Flying Service, Southern Air Transport and National Parks Airways.

A Limited Number of Real Bargains

We have on hand certain Super-Universals and other Fokker planes that have been used as *demonstrators* —at bargain prices. The list includes:

STANDARD UNIVERSAL	F-10A TRIMOTOR
SUPER-UNIVERSAL	F-11A AMPHIBIAN
F-14A MAIL PLANE	F-32

These airplanes are in splendid mechanical condition; "new" in appearance and are fully guaranteed by us. The number is limited but while they last, they represent exceptional profit opportunities.

• FOKKER •

AFFILIATED WITH GENERAL MOTORS CORPORATION

FOKKER AIRCRAFT CORPORATION OF AMERICA, GENERAL MOTORS BUILDING, NEW YORK

BRONZE BEARINGS

BALL BEARINGS

ROLLER BEARINGS

FORMICA control pulleys for aeroplanes are made in all the popular sizes in three types. You may have self-lubricating bronze bearings, ball bearings or roller bearings. The anti-friction bearings are available in metals that will not corrode because of salt air. They are lubricated so that operation is unaffected by great extremes of temperature. The pulley itself has very low moisture absorption and does not change its dimensions to an important extent either because of changes in temperature or humidity.

Formica also offers a line of fairlead bushings, and light, durable and very handsome lining for cabins in over 20 attractive colors.

Write for literature

THE FORMICA INSULATION COMPANY
4628 Spring Grove Avenue, Cincinnati, O.

FORMICA

"SPEED-FILTERING"

MEANS ALL IMPURITIES REMOVED AT 26 G.P.M.*

★ GALLONS PER MINUTE

G & B Filter Funnel—*modern high-speed filtering device, regular use of which "should add 200 hours to the life of a motor," according to aviation expert.*

LESS FIRE AND FIELD HAZARDS WITH THE G & B AEROPIT

Sooner or later it had to come—this fueling service purposely planned and built to fit airport needs! Airports are not street corners, nor do ships have the navigability of automobiles. That's why the G & B Aeropit takes gas out to the flying line. That's why, too, it lies flush with the ground so planes can run over it without danger. The Aeropit provides one-man fueling service—where such service is wanted—available 24 hours of the day. To both airport and operator it offers the maximum of convenience with the minimum of risk. Write for details.

This battery of 3 Aeropits at Le Bourget, France.

A few of many Aeropit-equipped airports:

Abilene, Tex.; Boston, Mass.; Cleveland, O.; Newark, N. J.; Kansas City, Kans.; Salt Lake City, Utah; Washington, D. C.; and Croyden, England.

● When you fill up your gas tank, you're really buying *power with safety*—uniform power which will wing you through space without a sputter from your motor. Unfortunately, as every airman knows, impurities find their way into fuel.

● We built our Filter Funnel to make sure you get water-free, dirt-free gas—*full-power gas*—at all times. Here's the efficient filter you've waited for, combining thoroughness with speed. By actual test the Filter Funnel has proved 23-gallons-a-minute faster than chamois doing the same job. Takes out water, as well as sand, lint and sediment, at 26 gallons per minute. It's a protection you can't afford to be without.

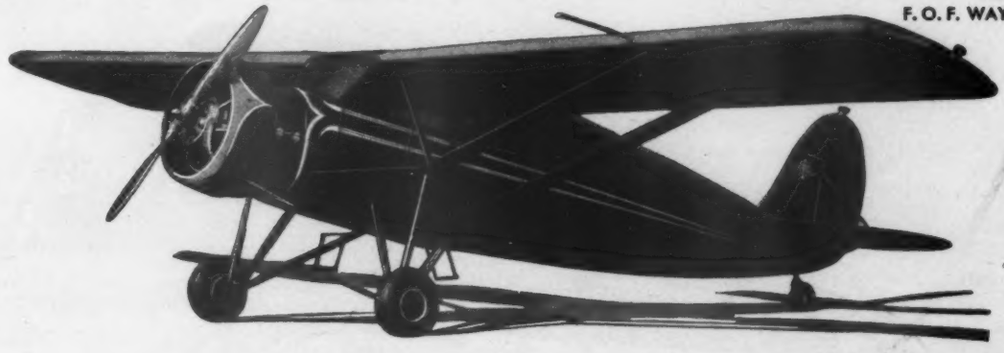
● Write for our report showing universal need for the Filter Funnel and proving that this filter can materially lessen the risk of motor trouble at take-offs or during flight. Free on request.

GILBERT AND BARKER
MANUFACTURING COMPANY
SPRINGFIELD MASS., U. S. A.
GASOLINE AND OIL FUELING EQUIPMENT

TRADE MARK G&B

STINSON $4995

F. O. F. WAYNE, MICH.



215 H. P. 4-Passenger Cabin Plane, with the

World's Champion Motor

Lycoming motors in Stinson planes operated by the New York-Philadelphia-Washington Airways alone have flown 780,300 consecutive engine miles without failure of any sort—a record, we believe, never before approached.

THE WORLD'S LARGEST BUILDER OF CABIN PLANES

The company that builds more cabin planes than all others combined offers this 4-passenger Cabin Plane at $4995. This is why Stinson is the accepted standard of aircraft value. Because of Stinson's long experience, vast resources, tremendous purchasing power, and manufacturing facilities, Stinson was the first to make it possible to buy this type of plane for less than $10,000. Being a part of a group of industries with $50,000,000 in assets, it is self-evident why Stinson alone offers a superior product for less cost. The Stinson plane has 51 advantages found in no other plane. Why pay more and get less? We invite you to write us for a list of these advantages. Also, it is significant that products that come from the group of which Stinson is a part, once established in design, remain unchanged for a long period. It is our belief that the design of this Stinson plane will be standard for many years to come.

OTHER STINSON PLANES: Four Passenger, 300 H. P. Wasp—$8,995 • Stinson Airliner Eleven Passenger Tri-Motored Transport—$25,900 • Eight Passenger, Tri-Motored Executives' Model, prices upon request. • All prices F. O. F. Wayne, Michigan. Equipment other than standard, extra. Prices subject to change without notice. Stinson Aircraft Corporation, Wayne, Michigan. • Division Cord Corporation.

POWERED BY LYCOMING

● The already famous new 4-place open cockpit 125 h.p. Kinner **BIRD** which can be fitted for dual instruction in ten seconds by folding forward the extra seat $4395

● **BIRD** 110 h.p. Warner 3-place open cockpit, dual control, approved type certificate No. 382, $4250.

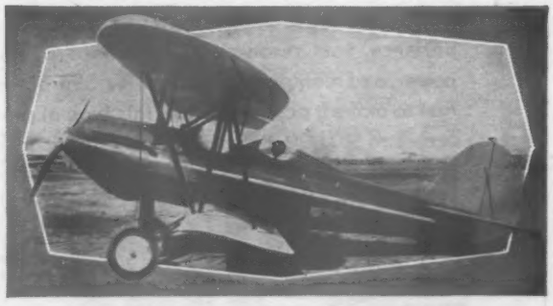
● **BIRD** 165 h.p. Wright 3-place open cockpit, dual control, approved type certificate No. 387, $5870.

THE MOST COMPLETE LINE OF AIRPLANES IN AMERICA TO INCREASE THE DEALERS' CHANCES FOR COMPLETE SUCCESS

BIRD AIRCRAFT CORP.

The SAFE *Airplane*

● A limited number of OX-5 **BIRDS**, approved type certificate No. 101, with new engines, are available at $2195



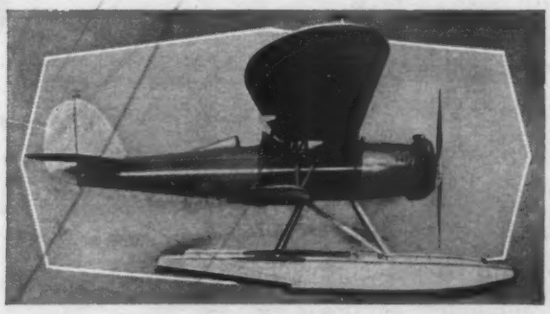
ALL BIRD PLANES ARE EQUIPPED

An outstanding 5-place Kinner-powered cabin plane at $4995, with efficiency to carry big payloads and all the safety for which the **BIRD** has always been famous.

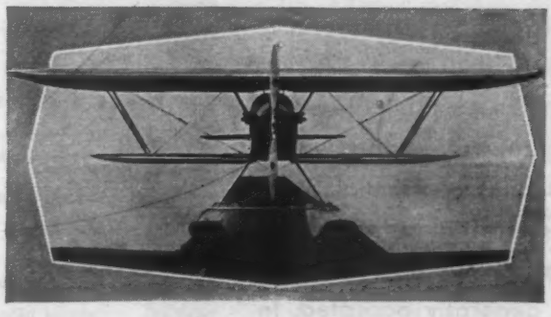
BIRD

PRICES THAT DEFY COMPETITION. A DEALERS' PLAN THAT MEANS REAL PROFITS. GET IN TOUCH WITH US AT THE FACTORY

GLENDALE, L. I., N. Y.



The 4-place Kinner **BIRD** equipped with pontoons has taken off repeatedly fully loaded to 2800 lbs. in 15 sec.



A seaplane with the performance of a land-plane. The land and water gears are quickly inter-changeable.

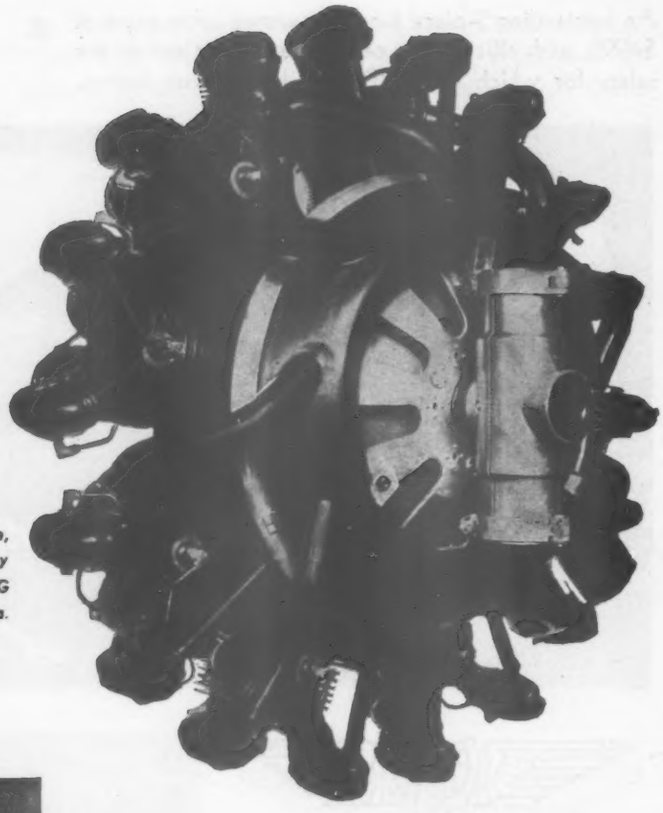
BIRD 100 h.p. 3-place open cockpit, dual control, approved type certificate No. 239. Price . . . $3895

The SAFE *Airplane*

WITH LUGGAGE COMPARTMENTS

In the LYCOMING... *it's* NICKEL STEEL

Dependable materials are the best assurance of dependable performance



Lycoming R-680 aero engine, A. T. C. No. 42. Manufactured by LYCOMING MANUFACTURING COMPANY, Williamsport, Pa.

● Lycoming...prominent builder of automotive and marine engines...has combined modern engineering skill with sound metallurgical practice in producing this 9-cylinder radial airplane motor. Especially significant is the use of Nickel and Nickel-chromium Steels for all parts subjected to stress or shock, as is shown in the appended table.

The high impact strength and uniformity of structure obtainable in heat-treated Nickel Alloy Steels make them the most suitable available material for airplane engine parts where unquestioned dependability is essential. Standard practice of the aircraft industry, both in America and in Europe, gives ample evidence that these facts are generally accepted. In addition to the Lycoming engine, more than 40 other well known models made in America employ Nickel Alloy Steels for vital parts.

Nickel Alloy Steels specified for various parts of Lycoming *engines:*

S. A. E. 3240
- Crankshaft
- Master rod
- Tachometer gears
- Tachometer shaft
- Valve rocker pin
- Distributor shaft plugs

S. A. E. 2515
- Cam follower roller guide

S. A. E. 2320
- Misc. Keys

S. A. E. 2330
- Exhaust pipe connection
- Thrust bearing nuts
- Propeller hub cone nuts
- Main bearing spacers

S. A. E. 3250
- Crankshaft bolts and nuts
- Cam follower
- Cam follower roller pins
- Valve keys
- Valve rocker roller pins
- Tachometer shaft sleeve
- Valve rocker sleeve

S. A. E. 3140
- Lifting Eye
- Cam spider rivets
- Valve rockers

S. A. E. 3115
- Cam
- Cam follower rollers

S. A. E. 3135
- All studs
- Misc. bolts
- Misc. nuts
- Misc. screws
- Distributor coupling
- Propeller hub pins
- Cam idler gear washer
- Crankshaft sleeve
- Crankshaft plugs
- Oil pump driven shaft

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK, N. Y.

Miners, refiners and rollers of Nickel...Sole producers of Monel Metal

Nickel
ALLOY STEEL
PERFORMS BETTER LONGER

INCO NICKEL

Send for new Directory of American Aircraft Engines

. . . THERE'S NO GAMBLE *on this quality*

Read these rapid-fire facts for those who think "all oil is just alike."

Gulfpride is the one aviation oil refined by the Aluminum Chloride process, using material which costs $100 per ton. Many other oils are refined with acid at $10 a ton. Gulfpride quickly demonstrates the difference in better lubrication, more air-hours between service overhauls, and a cleaner motor.

Gulfpride Oils leave less than one-fifth as much carbon residue (Conradson test) as the next best Paraffin Base Oil of comparable viscosity on the market. That is why Gulfpride makes a sweet motor stay sweet. There is nothing to foul her up. Ask for Gulfpride at the field.

Better lubrication . . . more air-hours between overhauls . . . and a cleaner motor.

MORE AIR HOURS

Gulfpride holds its body at high temperatures and resists breaking down under motor heat. It is highly resistant to oxidation and emulsifying action.

Gulfpride is made in five viscosities; 75-100-120-150 and 200 at 210° F, providing a superior lubricant for all types of aircraft motors, under all operating conditions.

Ask for Gulfpride and you'll never be grounded because of oil-caused trouble.

GULF REFINING COMPANY
General Sales Offices
Pittsburgh, Pa. U. S. A.

GULF *Gulfpride Oil*

• GULF REFINING COMPANY •

No. 8 of a series of advertisements on "How Superlative Quality is Built into Roebling Wire Rope".

Where *STEEL* gets its *STAMINA*

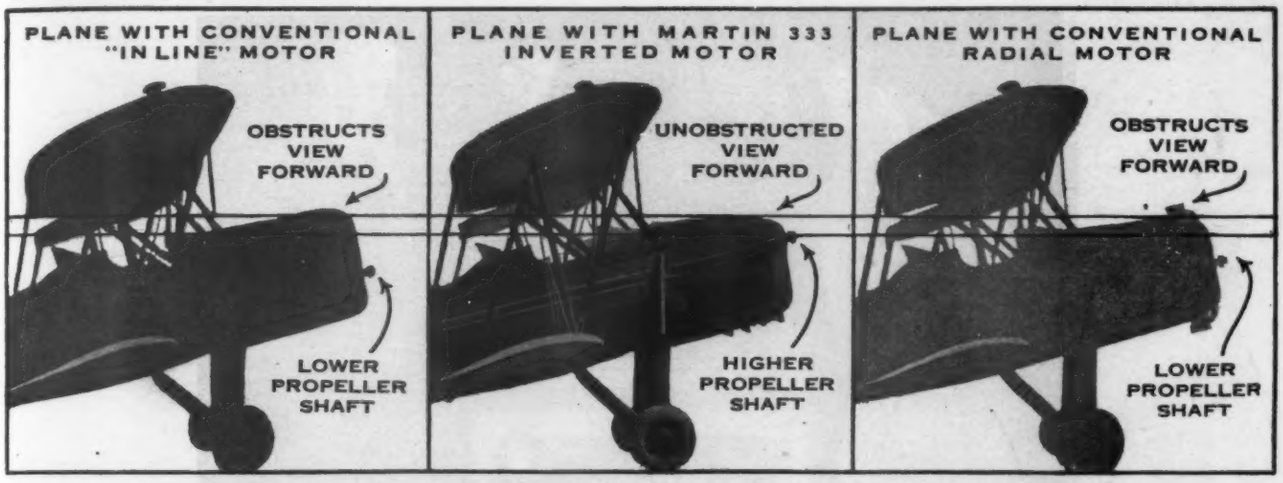
IT IS in the wire drawing mills that the wire for Roebling Wire Aircraft Products gets much of the toughness and durability for which it is famed.

Here, the wire is cold drawn through steel dies—in and out, again and again. Then at carefully calculated intervals it goes to the tempering furnaces—then back for further drawing. And during every step of this process, additional stamina is painstakingly "worked" into it.

At Roebling, wire drawing is considered of vital importance. Infinite care is exercised throughout the operation and the methods used are based on years of development. Only highly skilled wire drawers are employed and most of these men have had from 10 to 35 years of experience.

JOHN A. ROEBLING'S SONS COMPANY
WIRE . . . WIRE ROPE . . . WELDING WIRE . . . FLAT WIRE
COPPER *and* INSULATED WIRES AND CABLES
WIRE CLOTH *and* WIRE NETTING . . . *Export Dept., New York*
TRENTON, N. J. *Branches in Principal Cities*

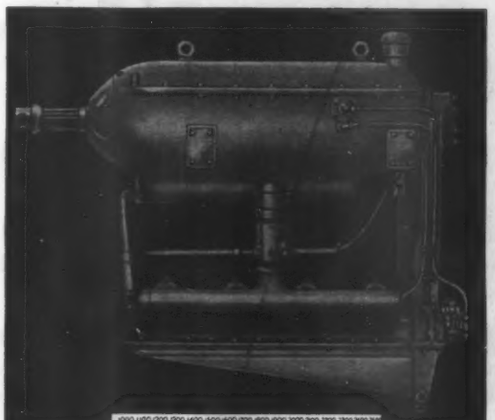
ROEBLING WIRE AIRCRAFT PRODUCTS

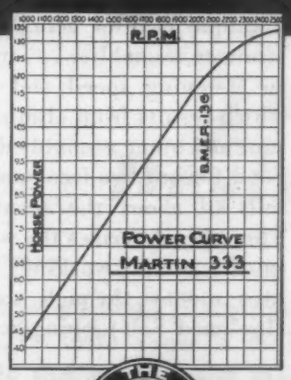


THE SILHOUETTES TELL THE STORY

- - - Cleaner Stream-lining, Greater Visibility and Higher Propeller Clearance with the

MARTIN 333 INVERTED MOTOR





CLEANER stream-lining is obvious at a glance. Greater visibility forward is made equally apparent by the upper horizontal line across the three silhouettes. Higher propeller clearance is plainly indicated by the lower line—drawn through the propeller shaft of the Martin Motored plane. To obtain equal clearance with a conventional "in-line" or radial motor, it would be necessary to increase the height of the landing gear by 8 to 15 inches.

Notice also in the illustration above how the short, direct exhaust stacks of the Martin 333 Motor discharge through the bottom of the fuselage, thus protecting the pilot from hot exhaust fumes.

A few of the many other important advantages are: 120 horsepower at 2100 R. P. M. from a motor weighing 265 lbs. No push rods or rocker arms to oil and grease. No valve clearances to check and adjust. Valves are kept in a constant bath of oil, and the only oiling job on the entire motor is putting oil in the oil tank.

To airplane manufacturers and others interested in the inverted, four-in-line Martin 333 Motor (A. T. C. No. 59) we shall be glad to send further information and detailed specifications upon request.

THE GLENN L. MARTIN MOTORS COMPANY
BALTIMORE MARYLAND U.S.A.

THE GLENN L. MARTIN MOTORS CO.

A Subsidiary of the Glenn L. Martin Company ◆ Baltimore, Maryland, U.S.A.

559,750 metal-twisting JOLTS

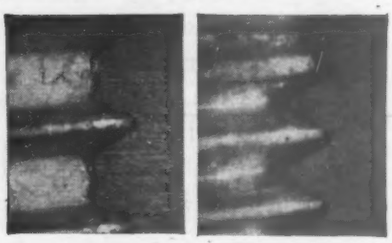
. . . but Self-tapping Screws DID NOT LOOSEN

From the Columbia University Testing Laboratories comes further proof that a manufacturer does not sacrifice assembly security when he takes advantage of the fastening economies afforded by Hardened Self-tapping Screws:—

By means of a special shake-test machine, a radio receiver taken right from the stock of the maker was subjected to exceptionally heavy vibration stresses. So severe was the vibration that many of the sheet metal parts of the set were twisted and broken. It was a stiff test for assemblies because vibration is the chief cause of fastening failure. The six assemblies made with machine screws could not stand such a jolting . . . they quickly fell apart. Yet not one of the 44 fastenings made with Self-tapping Screws loosened.

Other unbiased, scientific tests show that under tension and shear stresses, too, Self-tapping Screws hold better than the fastening devices they usually replace. The user of these unique Screws actually obtains stronger assemblies . . . in addition to fastening speed and economy, which results from eliminating tapping and other assembly difficulties. Send for our two free booklets. One tells all about the security tests. The other describes the way leaders in the metal working industries save money through the use of Hardened Self-tapping Screws.

These microphotographs tell the story



See tight engagement of Self-tapping Screw in metal

Note loose fit of machine screw in tapped hole

PARKER-KALON HARDENED SELF-TAPPING Sheet Metal Screws

PATENTED · APR. 1, 1919 — No. 1299833 — MAR. 28, 1922 — No. 1411104 AUG. 16, 1923 — No. 1465148 — FEB. 10, 1925 — No. 1526162 — OTHERS PENDING

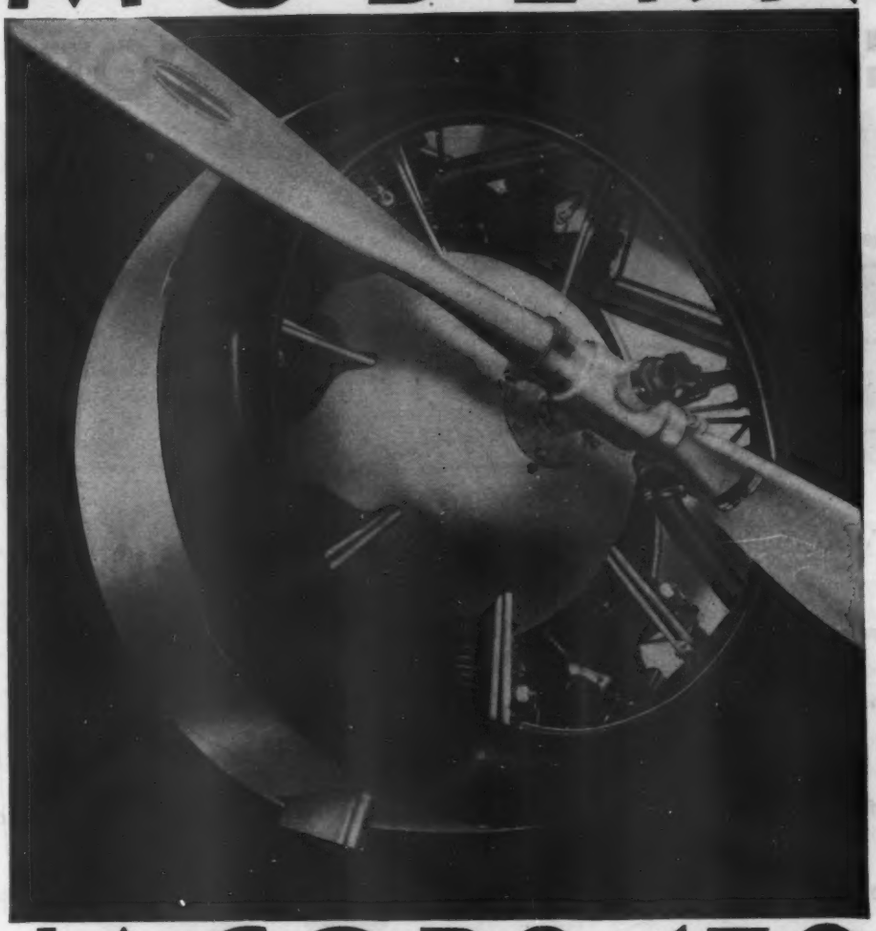
PARKER-KALON CORPORATION, Dept. M., 192-200 Varick Street, New York, N. Y.

Send me free booklets on the Security and Economy of assemblies made with Self-tapping Screws.

Name and Co.

Address

MODERN



JACOBS 150

The Only Engine Designed for Cowling

JACOBS 150 is the only Engine designed for cowling ring. The exposed rocker arms of the JACOBS allow it to be serviced more easily and quickly with the cowling in place than the ordinary Engine without cowling.

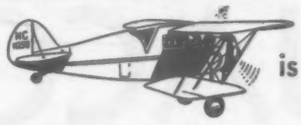
Made of the finest heat-treated alloy steel and aluminum, each part is precision tested for minute accuracy. Furnished with mounting board and combination collector ring and cowling. A COMPLETE POWER UNIT.

JACOBS AIRCRAFT ENGINE CO.

CENTRAL AIRPORT

CAMDEN, NEW JERSEY

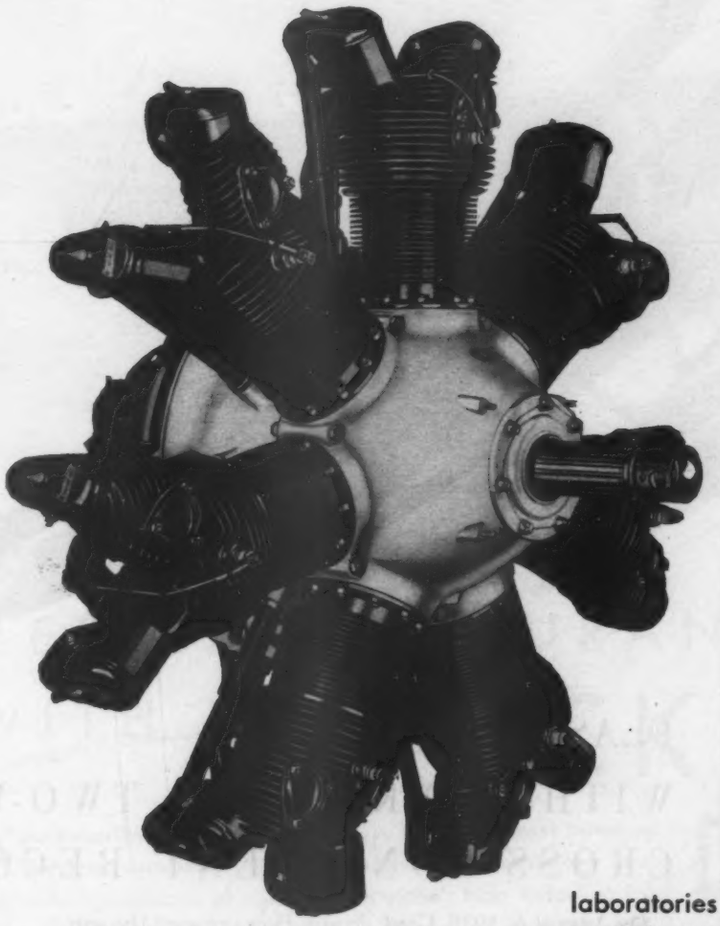
THE WACO LINE FOR 1931

THE WACO line for 1931 includes a complete range of models to satisfy every normal requirement for private ownership and commercial operation. The popular "F" series, still further refined, remains the backbone of the line... It was the outstanding new airplane design of 1930 and led all others in sales... It is available with Kinner, Warner and Menasco power plants... and also, in the "Model F-2", with Continental 165 h. p. engine. • The "Model C"  is WACO's bid for leadership likewise in the field of cabin airplanes . . . Shown for the first time at Detroit last month, it was one of the sensations of the Show. • At higher prices are the famous Wright-powered WACOs... the stalwart "225" Straight-Wing and the spectacular Taper-Wing . . . holders of numerous records, consistent winners of countless air events. • The price range is from $4450 to $8525... Heywood starters are standard equipment on all models . . . and WACO prices, as always, include *complete* equipment, flyaway, without any extras to be added. Full details on request.

WACO AIRPLANES

THE WACO AIRCRAFT COMPANY...TROY, OHIO. "ASK ANY PILOT"

Undivided Responsibility



THE LIGHTEST 165 H.P. AIRCRAFT ENGINE ON THE MARKET
7-cylinder radial. 165 h.p. at 2000 r.p.m.
Navy test rating 177 h.p.

The Continental A-70 second series 165 h.p. aircraft engine is thoroughbred. From design to finished product this engine carries the responsibility and reputation of Continental.

All raw materials are subjected to complete chemical analysis and physical test at the Continental laboratories before the first machining process is started. Every machine process—every test—is conducted by Continental at the Continental plant—and must meet Continental's rigid specifications for acceptance.

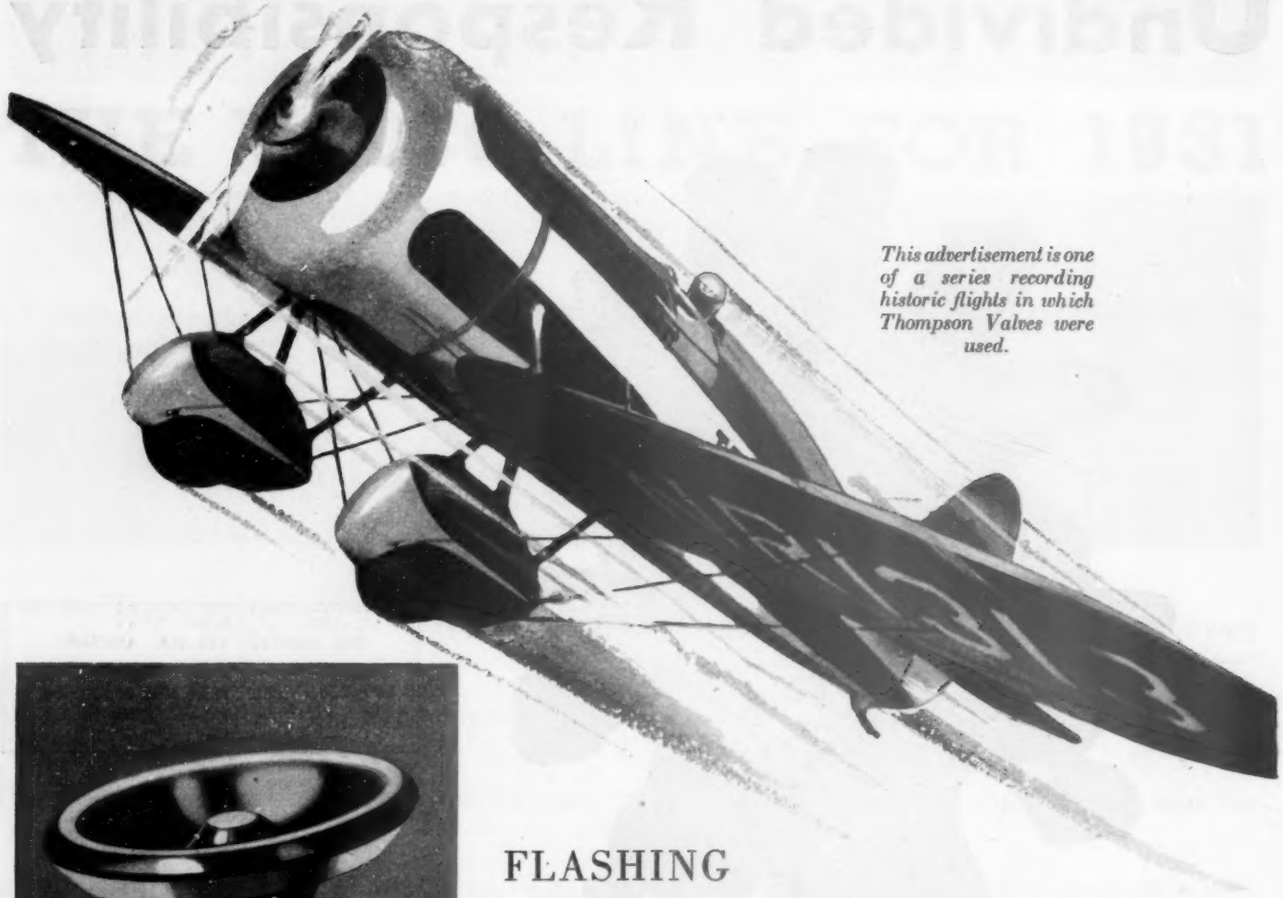
This means that the Continental guarantee is based on *a Continental-built engine* —and that their responsibility to you is UNDIVIDED.

CONTINENTAL AIRCRAFT ENGINE COMPANY
General Office and Factory, Detroit, Michigan

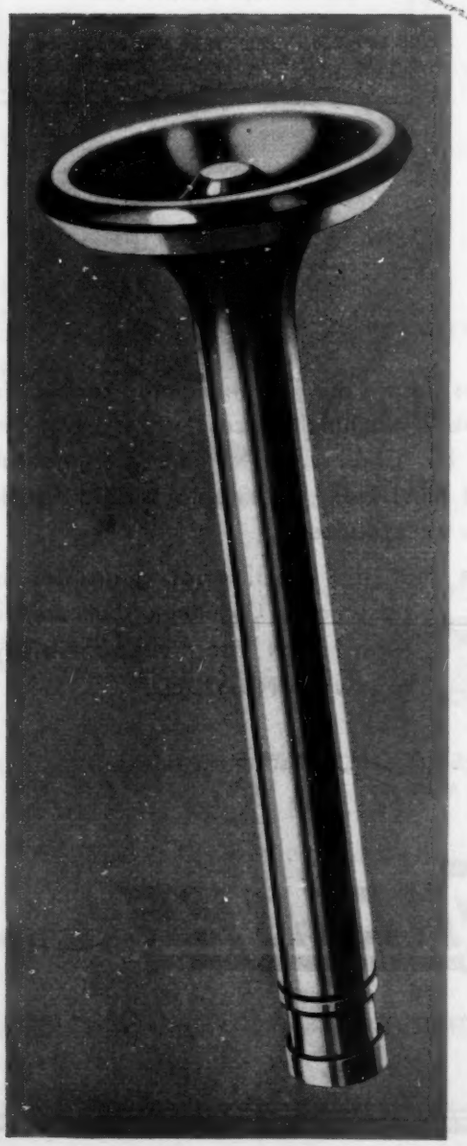
Continental Engines

for the airways of America

FAMOUS FLIGHTS WITH THOMPSON VALVES



This advertisement is one of a series recording historic flights in which Thompson Valves were used.



FLASHING WITH HAWKS FOR A TWO-WAY CROSS-CONTINENT RECORD

On August 6, 1930, Capt. Frank Hawks raced the sun westward from New York to Los Angeles in his trim little Travel-Air monoplane, setting a record non-stop mark of 14 hours and 50 minutes against the prevailing winds. A week later, taking off before dawn for the return trip eastward, he kept a dinner engagement 2800 miles away after only 12 hours and 25 minutes of flying!

Across the continent and back in elapsed time hardly greater than the span of a single day! Naturally, such remarkable speed imposed a grueling test on the Wright Whirlwind motor that made it possible. And, naturally, like so many other motors of leading makes which have come through such record-breaking tests with flying colors, it was equipped with eighteen Thompson Valves.

THOMPSON PRODUCTS, INCORPORATED
General Offices: Cleveland, Ohio, U. S. A.
Factories: CLEVELAND and DETROIT

Thompson Valves

73 HOURS WITHOUT REFUELING!

Exceeding AMERICAN ENDURANCE RECORD WITH THE PACKARD-DIESEL

AT Jacksonville last month a 225 h. p. Packard-Diesel powered Bellanca exceeded the American and came within one hour and thirty-five minutes of equaling the world's Non-Refueling Endurance Flight Record. Taking-off in 31 seconds on April 12th with a gross load of 6,666 pounds, including 458 gallons of fuel oil, the ship stayed aloft 73 hours and 48 minutes—exceeding by 14 hours and 29 minutes the American record made in 1928 by Brock and Schlee with a 225 h. p. gas engine.

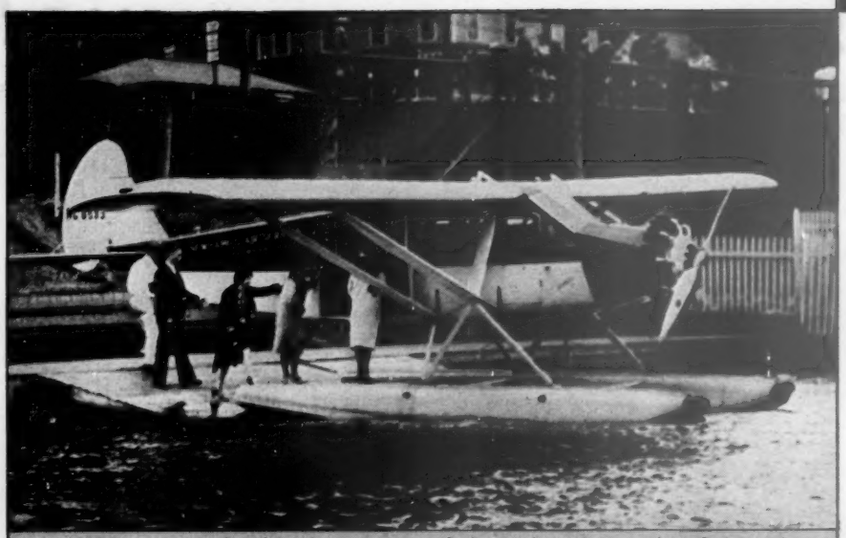
Only a violent storm accompanied by total loss of visibility, which forced the Bellanca down with engine functioning perfectly and with enough reserve fuel for several hours of additional flight, prevented the almost certain capture of the world's Non-Refueling Endurance Record of 75 hours, 23 minutes. This record is recognized as one of the most important and sought-after records in aviation, for not only must the powerplant function perfectly and economically during the grueling flight but at the start it must pull a tremendous load off the ground.

The power, endurance and economy demonstrated by the Packard-Diesel on this phenomenal flight are but typical of its every-day performance. To commercial operators and air-line owners the Packard-Diesel points the way to greater pay-loads and increased reliability of operation under all flying conditions.

Walter Lees, left, pilot, and Frederic A. Brossy, co-pilot of Packard-Diesel powered Bellanca on the record-exceeding flight.

PACKARD MOTOR CAR COMPANY
DETROIT, MICHIGAN

ASK THE MAN WHO OWNS ONE



Sparkling water and sunlit skies—vacationists find new pleasure in seaplane flights and operators find new profits.

Eager passengers await their turn beside a wooded lake.

An hour to summer camp from city home—100 miles away.

Seaplane landing privileges are not costly—often free.

IT'S TIME TO TALK TRANSPORT

Pay load days are here again—on the water! Operators who plan now to convert their land planes to seaplanes with EDO all-metal Floats will find plentiful profit in bringing short hop, charter and commuting service to the unnumbered thousands who seek their recreation near the water.

Practically any well-known make of plane may be licensed on an interchangeable, standardized EDO installation. EDO Floats are ready now for prompt shipment. Full particulars and cooperation is yours for the asking. Address EDO Aircraft Corporation, 600 Second Street, College Point, Long Island, N.Y.

Fogg's Navy at Lake Winnipesaukee. Robert S. Fogg (at left)

EDO

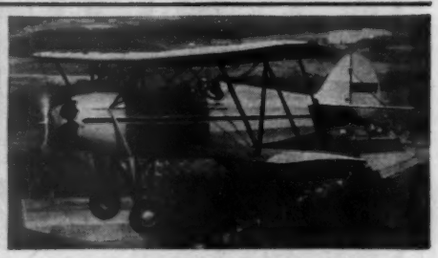
THE FLOAT MAKERS

Announcing . . . the new type "HEYWOOD STARTER" as standard equipment on all "WACO" planes

SKY SERVICE

Model "MNF"—Three place open plane powered with MENASCO PIRATE 120 H. P.

Model "C"—Four place cabin biplane powered with A 70-2 165 H. P. CONTINENTAL



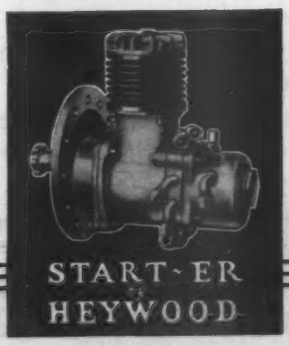
Model "RNF"—Three place open plane powered with WARNER "SCARAB" 110 H. P.

Model "INF"—Three place open plane powered with KINNER B-5 125 H. P.

Model "F2"—Three place open plane powered with CONTINENTAL A 70-2 165 H. P.

Waco "TAPER WING"—Three place open plane powered with WRIGHT "WHIRLWIND" 240 H. P.

HEYWOOD STARTERS



The WACO Aircraft Co., largest producer of aircraft in the country has adopted the Heywood Starter as standard equipment on all planes.

Here indeed is a whole hearted endorsement of the worth of the Heywood!

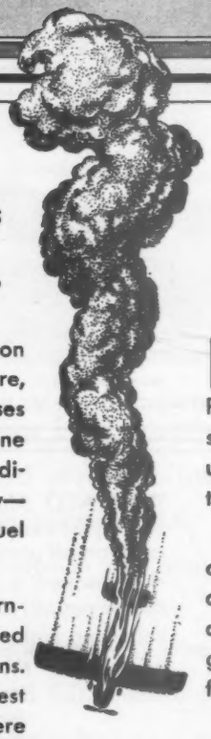
Following is the list of planes manufactured by WACO:

Model "RNF" Three place open plane
Model "INF" Three place open plane
Model "C" Four Place Cabin Biplane
Model "F2" Three place open plane
Model "MNF" Three place open plane
WACO Taper Wing Three place open plane
WACO "225" Straight Wing

Long characterized by the great care used in engineering, design, and construction, WACO again shows outstanding progressiveness by the adoption of the Heywood Starter. Each purchaser is now offered the beauty, safety and dependability for which WACO is famous, together with the convenience of sure, instantaneous starting from the pilot's seat, afforded by the Heywood Starter.

SKY SPECIALTIES CORPORATION
3651 Hart Avenue - - Detroit, Michigan

Now 2 More Perils of Flying have been banished



The LUX Extinguisher Takes the Terror Out of Fire . . . .

ENGINE fires hold no terrors for those who fly on Lux protected planes. At the first sign of fire, one quick pull on the Lux control handle releases the Lux Extinguisher and envelops the entire engine in a harmless cloud of fire-smothering carbon dioxide gas. All flames are extinguished instantly—even those in gasoline flowing from a broken fuel line — for fire cannot exist in carbon dioxide.

Two departments of the United States government and several transport operators have tested the Lux Extinguisher under actual flying conditions. In these tests, Lux extinguished fires in the severest slipstreams, against which all other devices were ineffective. So amazing were results that over 300 planes have been equipped with Lux Extinguishers during the past year.

Investigate the new Lux Extinguisher. It is available in sizes suited for single, twin and tri-motored planes.

Hahn Shielded Plugs Assure Perfect Radio Communication

IN STORMS, fog or darkness, perfect radio communication often prevents disaster. Hahn Spark Plugs, in conjunction with shielded harness and shielded magnetos, make it possible for you to pick up weather broadcasts and beacon signals without the slightest interference from the ignition system.

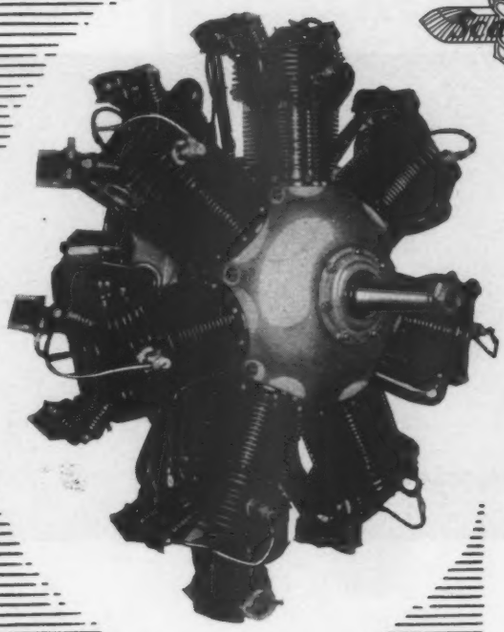
Five air transport lines are using Hahn Plugs, not only because they are radio-shielded, but because of their remarkable operating characteristics. They are moisture proof, non-fouling in hot or cold engines and will not pre-ignite. In service, Hahn Plugs frequently run for more than 400 flying hours.

Hahn Plugs are insulated with mica. The electrodes are a radical improvement in spark plug design. Their large area prevents burning away and assures a constant gap.

If you are interested in radio-shielding or improving engine performance, investigate the Hahn Plug.

Folders describing Hahn Plugs or LUX Extinguishers will gladly be sent upon request.

Walter Kidde & Company Inc., 140 Cedar Street, New York



ACE-HIGH

with the Pilot

Warner makes no claim to being first choice of every individual pilot.

Personal preference and other factors play too strong a part for that.

But Warner can say, that almost universally, pilots proclaim Warner design and Warner performance to be of the highest calibre.

Such a preponderance of favorable opinion can mean but one thing. That Warner has succeeded in doing that which it set out to do—to build an engine which in its power class would be pre-eminent and give that type of performance which every Warner buyer has the right to expect.

WARNER AIRCRAFT CORPORATION
DETROIT, MICHIGAN

Warner engines are made in two sizes—the 7 Cyl. 110 H. P. Warner Scarab and the 5 Cyl. 90 H. P. Warner Scarab Junior.

WARNER "Scarab" ENGINES

ROY W. HOWARD

Chairman of the Board
Scripps-Howard Newspapers

● "The twenty-five Scripps-Howard newspapers are members of the Audit Bureau of Circulations because of their high regard for the Bureau's integrity and efficiency. The A. B. C. has provided the advertiser and his agent with the yardstick for intelligent buying of advertising space. The almost all inclusive membership in the Bureau is a tribute to the high standards of honesty prevailing in the publishing business."

ADOLPH S. OCHS

Publisher
The New York Times

● "The ABC of circulation is good—essential—as far as it goes; but there are twenty-three more letters in the alphabet of advertising, and knowledge of their application is also essential for the intelligent use of A. B. C. reports. 'All is not gold that glisteneth.' A printing press and a sheet of paper are not all that is necessary to make a newspaper, nor is the number of circulated copies the only information necessary to measure the value of newspaper space."

As one of the leaders in American journalism puts it, "—nor is the number of circulated copies the only information necessary to measure the value of newspaper space."

An A. B. C. report is full of other information quite as important to the advertiser as the number of copies of the publication distributed. Men whose business it is to buy space should read every page of an A. B. C. report, for therein they will find answers to every question an advertiser wants answered. Only thus can they judge whether or not the publication will meet the requirements demanded.

Advertisers, publishers and agencies are working to give the advertiser—for whom the service is planned—this only complete, accurate knowledge about a publication's circulation. The maintenance of the organization which makes these facts available is vital to every advertiser. To help support it costs each an insignificant sum as compared with what it saves each advertiser yearly.

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Complete information regarding membership may be had upon request.

An advertisement by the
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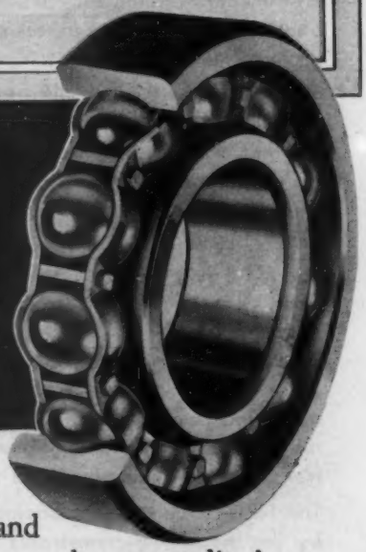
Executive Offices • • • Chicago

The WASP JUNIOR ENGINE
LATEST POWER UNIT BY
PRATT & WHITNEY

STINSON MONOPLANE equipped with Wasp Junior engine — recently purchased from Stinson Aircraft Co., by Felix Dupont, Jr.

uses SRB AVIATION BALL BEARINGS



LATEST addition to the Pratt & Whitney line is the Wasp Junior —a nine cylinder, 300-400 horsepower engine possessing all the mechanical craftsmanship and performance of this famous family. It uses SRB Ball Bearings—further demonstrating the confidence for performance that leading engine manufacturers place in SRB Aviation Ball Bearings.

Many noted world and American aircraft records are credited to Wasp and Hornet engines—proving the dependable flying power of Pratt & Whitney units. These records, too, show the undeniable reliability of SRB Ball Bearings—also used in Wasp and Hornet engines for many years.

STANDARD STEEL AND BEARINGS INCORPORATED
Plainville DIVISION OF MARLIN-ROCKWELL CORPORATION *Connecticut*

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Choose a flying school backed by

LEADERS

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EXECUTIVES of the United Aircraft & Transport Corp. planned Boeing School courses—to give you exactly the kind of training the industry will demand. These men are acknowledged leaders in airplane design and manufacture and in transport operations. From daily experience they know why some beginners fail and why others succeed.

Likewise, the 18 instructors are practical, successful men, who know the vast difference between a headful of theories and what you'll need when you tackle your first job. These veteran air mail and army pilots and technical specialists of long experience were attracted to the Boeing School by its prestige and by its unequalled laboratory, shop and flying equipment.

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The high percentage of Boeing graduates employed by the industry demonstrates the confidence of responsible companies in Boeing training. Mail the coupon below—today—for full details.

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SCHOOL OF AERONAUTICS

Division of United Aircraft & Transport Corp.

BOEING SCHOOL OF AERONAUTICS
Room 5-C, Airport, Oakland, California.

Gentlemen: I am interested in

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An AIRCRAFT RECEIVER Adjustable to the ENTIRE AIRCRAFT RADIO SPECTRUM

Model D Stromberg-Carlson Aircraft Receiver equipped with Eveready Raytheon 4-Pillar Tubes and powered by Eveready Dry Batteries. Over-all Dimensions of Receiver and Mounting Base: 16½ x 9¾ x 9¼ inches. Weight: 18 pounds. Licensed Under: A. T. & T. Co., R. C. A., R. F. L. and Aircraft Radio Corp. Patents.

INTERCHANGEABLE Coil Sets make the new Model D Stromberg-Carlson Aircraft Receiver adaptable to the entire radio spectrum. These coil sets are mounted upon an individual panel with handle attached, which may be inserted or removed, easily and quickly, at the will of the operator.

Besides its universal serviceability, Model D Aircraft Receiver is exceptionally light in weight, yet rugged and durable; it is extremely simple in design, yet highly sensitive and selective; and it is absolutely dependable under the most adverse weather conditions.

Write for our new brochure containing full information.

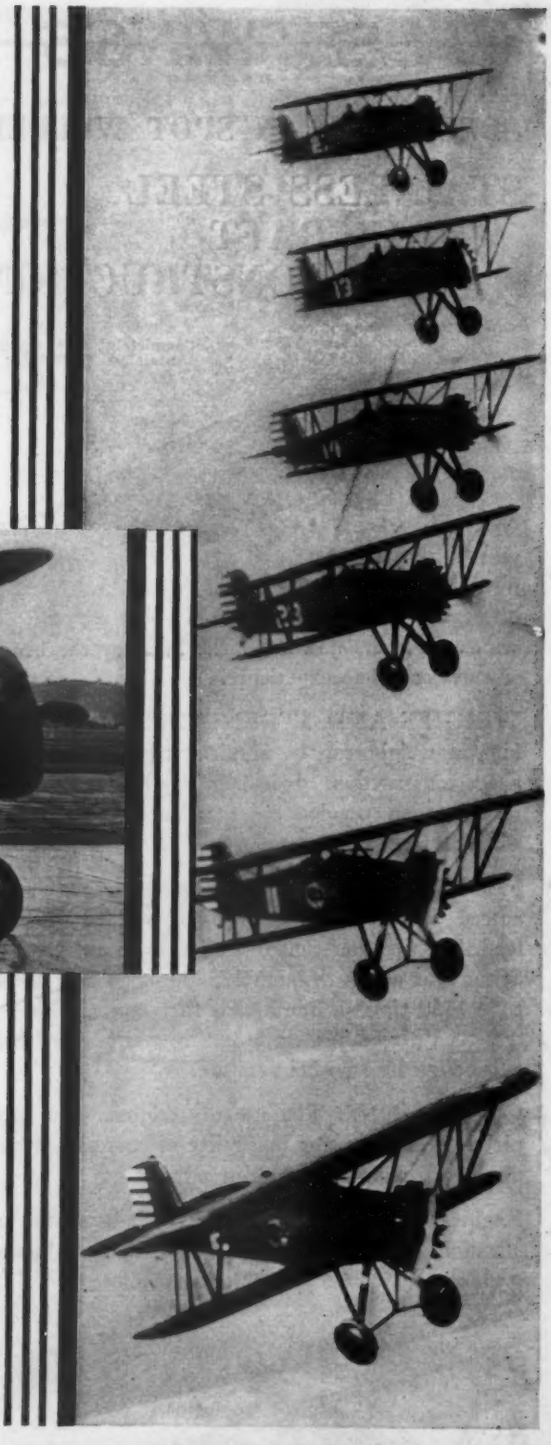
Stromberg-Carlson Telephone Mfg. Co., Rochester, N. Y.

Address all inquiries to our Sales Representative: Aircraft Radio Corporation, Boonton, N. J.

Stromberg-Carlson

Makers of Voice Transmission and Voice Reception Apparatus for More Than 35 Years

This thoroughbred fighter has *proved* what BOEING STAMINA means!



Above—the Wasp-powered Boeing P-12C Army fighter.
Right—Air Corps photo showing Boeing P-12B fighters on flight that set a new international altitude record.

YOU can pull this plane out of a 10,000-foot vertical power dive at 350 miles an hour! In 6½ minutes it can take off with full military load, climb 10,000 feet and return to the ground!

Eighteen Boeing fighters of the 95th Army Pursuit Squadron climbed in unbroken formation to an altitude of 29,000 feet, an international record. Planes of this type have reached altitudes as high as 33,000 feet.

No ordinary plane could stand what is simple routine for Boeing fighters . . . dog fighting in rarified, freezing atmospheres . . . the shock of hundreds of landings on airplane carriers . . . spectacular high-speed maneuvers in wing-and-tail formation . . . 5-mile-a-minute dives with bombs.

There is no substitute for Boeing stamina—built into commercial as well as military planes.

BOEING
AIRPLANE COMPANY
SEATTLE, WASH.

A Division of United Aircraft and Transport Corp.

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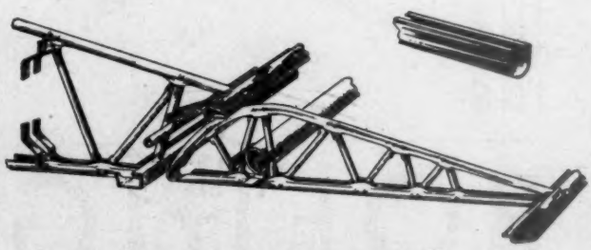
After two years' development in spot welding of stainless steel, Fleetwings engineers now offer the industry the benefit of their complete experience.

WEIGHT AND STRENGTH. Material savings in weight can be obtained by the use of the above construction. It is definitely lighter and more reliable than wooden construction, dural or torch welded steel structures.

FATIGUE. Our spot welded structures are guaranteed against fatigue. A spot welded rib was loaded to fifty per cent of design load and vibrated at the spar points through 1/32nd of an inch amplitude 1150 times a minute for fifty hours. The rib was then placed in a static testing machine and held full design load without failure.

CORROSION. The use of stainless steel completely eliminates any possibility of corrosion taking place even from salt water or salt air.

Engineers are invited to consult with us on the application of stainless steel to their design production problems. Write for technical data sheet.



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ROOSEVELT FIELD,
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Reliable
Uniform
Safe

The unvarying dependability of Williams' Aircraft forgings results from efficient laboratory analyses of material and direct supervision of the various manufacturing processes by a competent metallurgical staff.

A well-equipped Chemical and Physical Laboratory and complete forging and heat-treating facilities combine with a half-century of experience in enabling us to positively guarantee every Williams' forging to meet specifications.

Any shape, any material and any size up to 350 lbs.

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Send us your inquiries for coil springs, flat springs, wire forms, and small stampings

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Guarding the *Aviation Industry* with copper-steel

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Cyclone—not a "type" of fence—but fence made exclusively by Cyclone Fence Company and identified by this trademark.

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● When a firm maintains the uniform excellence of its product for nearly half a century—that fact becomes a tradition of which it can well be proud.

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The standard since 1884 needs no introduction —it stands on its record.

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THE ZAPON COMPANY

A Division of Atlas Powder Company

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The Aircraft Mechanics' Handbook

by I. W. MILLER
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174 pages, 4½ x 7
38 illustrations, $2.00

IN CONCISE reference form this book covers all the information needed by the airplane mechanic—tools, materials, standards, methods, data, inspection and repairs. Everything is described in simple form for the practical man, yet thoroughly in keeping with government standards and the demands of service and safety.

This book covers

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—compass correction

—excerpts from the "Air Commerce Regulations"

—many notes on miscellaneous shop work, etc.

Everything is covered in practical language, and made clear with illustrations, definitions, tables, etc. Throughout, the book represents the most valuable combination of practical guidebook material together with a due regard for the importance of the work and the high standards necessary. Standards and methods are in the main those of the government services.

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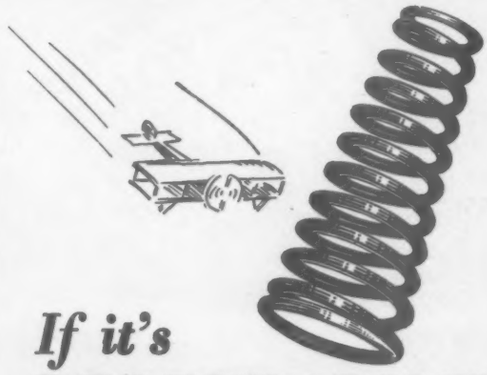

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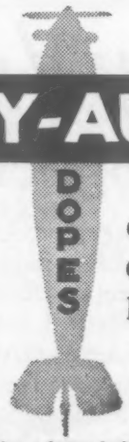

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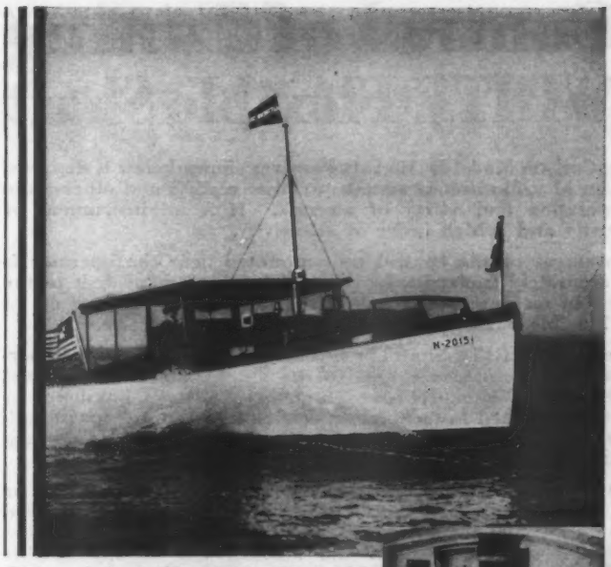

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NOWHERE has the slogan "Put It Together With Screws" a more significant application than in the yards of a yacht builder.

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American Screws have gimlet points which are easy to start, true-running threads which are easy to drive and deep slots and tough heads which make insertion easy.

You can do any job better with American Screws. Ask for them by name

WOOD SCREWS | TIRE BOLTS | STOVE BOLTS | MACHINE SCREWS

AMERICAN SCREW CO.

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WESTERN DEPOT, 225 WEST RANDOLPH ST. CHICAGO, ILL.

"Put It Together With Screws"

A GOOD INVESTMENT

for Business or Pleasure

LOWEST PRICED AMPHIBION IN THE WORLD

$5,800... PRIVATEER!

PRIVATEER'S economy of operation and remarkably low price of $5,800—several thousand dollars lower than that of any other amphibion in the world—mark it as an outstanding investment for the three great air-minded classes, flying schools, salesmen and sportsmen.

Rugged of construction . . . smart in appearance . . . the two-place open cockpit monoplane PRIVATEER (A. T. C. 370) is designed and manufactured by pioneer makers of amphibions. In stiff tests it has shown unusual stability, ease of control and maneuverability . . . and its adaptability to landing condition—snow, ice, rough terrain and water considered—has amazed experienced pilots. Flying range adequate for all reasonable needs . . . motor parts extremely easy of access.

A dependable Warner "Scarab" motor of 110 h. p. provides a high speed of 95 miles per hour . . . a cruising speed of 75 . . . a landing speed of 41 . . . a climb of 650 feet per minute . . . a cruising range of 250 miles. All this with a useful load of 600 lbs.—performance aplenty.

Naturally, because it is ideally suited for the use of the three great air-minded classes, dealers who sell the PRIVATEER have entry into a vast market. Just as the purchase of a PRIVATEER is a good investment for its owner, so is a territorial appointment for distribution . . . for Amphibions, Inc. dealer policy provides a liberal profit on each sale.

For complete information concerning the territorial appointments that are now being made, write or wire

PRIVATEER
$5,800 (Fly-away at Factory)
A. T. C. 370
Weight Empty, 1350 lbs.
Gross Weight, 1950 lbs.
Standard Equipment
Warner "Scarab" 110 h. p.
Paragon Pusher Propeller
Heywood Injection Starter
Low Pressure Tires
Fuel Level Gauge
Tachometer
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Air Speed Indicator
Altimeter, Tools, Anchor
Rope, Cockpit Cover
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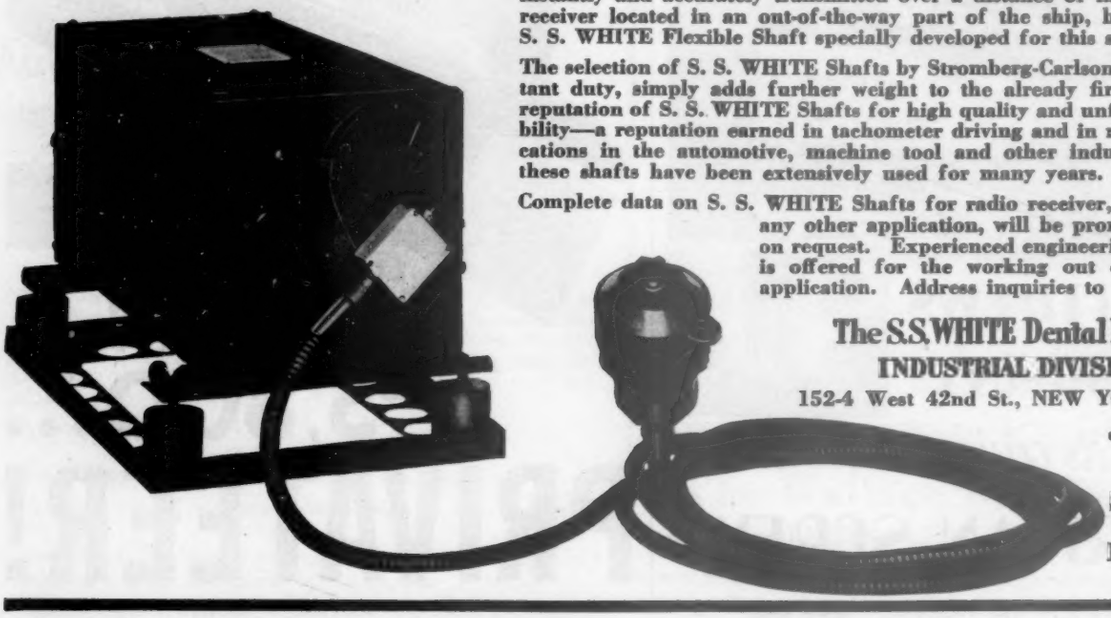
AMPHIBIONS, INC.

GARDEN CITY NEW YORK

Sensitive Remote Control of Tuning accomplished with S.S.WHITE Flexible Shaft

STROMBERG-CARLSON AIRCRAFT RADIO RECEIVER equipped with S. S. WHITE Flexible Shaft. Shaft is supplied to any desired length.



The Stromberg-Carlson Model D Aircraft Receiver shown below is designed for the reception of radio beacon signals, weather reports and other radio aids to the operation and safety of aircraft. It is an instrument of extreme sensitivity and a high order of selectivity.

The finest movement of the control unit mounted near the operator is instantly and accurately transmitted over a distance of many feet to the receiver located in an out-of-the-way part of the ship, by means of an S. S. WHITE Flexible Shaft specially developed for this service.

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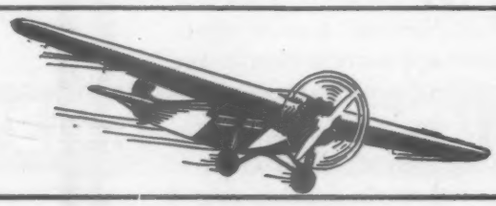

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FLY *with* CHAMPIONS

● When you think of spark plugs one name stands out from the rank and file.

That name is Champion — not only a name, but also a fact.

For the past two decades only the best of engineering has survived. During this period the preference for Champion spark plugs has constantly grown.

They have been the choice as original equipment on the majority of motor cars of the world. They have enjoyed the preference of the majority of individual motor car owners.

Champion Aero Type spark plugs incorporate all the time-proved and exclusive Champion advantages, and are specifically built to render better performance in aircraft engines.

The unique design of Champion Aero Types affords practical immunity from pre-ignition and fouling. In addition the dual insulators of Champion sillimanite—not porcelain—are so constructed that engine operation positively cannot be interfered with, even in the remote possibility of breakage.

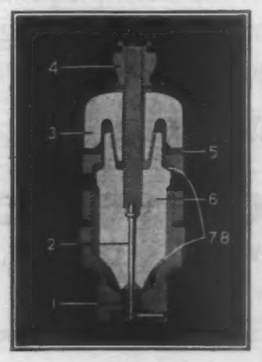
Fly with Champions, for their championship performance is traditional, and eloquently borne out by the fact that they continue year after year to excel and outsell throughout the world.

New Improved

CHAMPION

Spark Plugs for Aviation

TOLEDO, OHIO **WINDSOR, ONT.**



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ELGIN announces two NEW Aviation Clocks

ELGIN Model WC—Eight-day clock with sweep second hand. Specially adjusted to heat and cold and three positions. Front wind and set. Shown here actual size.

NEW in convenience—new in appearance—but with the same unfailing accuracy of all ELGIN products—these new ELGIN Clocks offer features that you will value during every hour of flying. We urge you to write for detailed information.

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ELGIN

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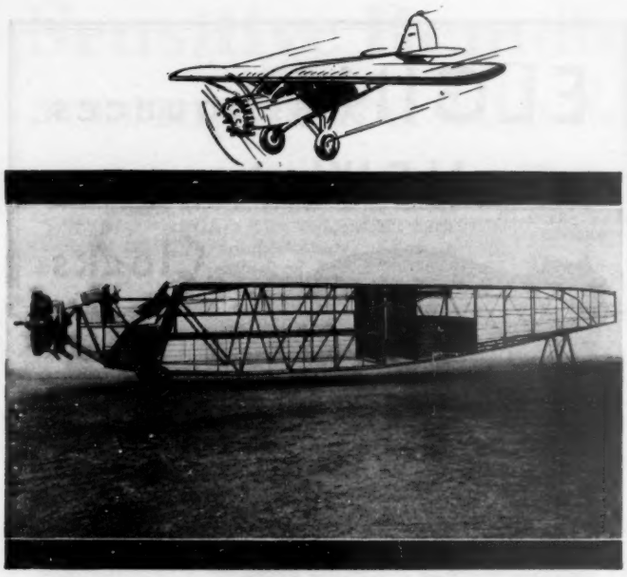

YOU KNOW HOW TO BUILD AIRPLANES

WE KNOW HOW TO MAKE AIRPLANE TUBING

We have doubled our capacity for airplane tubing. We have installed special equipment . . . and lots of it . . . solely to enable us to serve the airplane industry to even better advantage.

So, we can provide you with any type of airplane tubing you require. All made to meet government requirements. All made to combine light weight, strength and dependability.

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Jaeger clocks cover every conceivable demand for aviation use as shown by the models herewith presented.

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2. 8 Day Time-of-Flight Clock. Enables finding of elapsed time without calculation.
3. Chronoflite — a new Jaeger model which incorporates features of both the Chronograph and Time-of-Flight instruments. Stop watch, elapsed time and 8 Day Clock in the one instrument.
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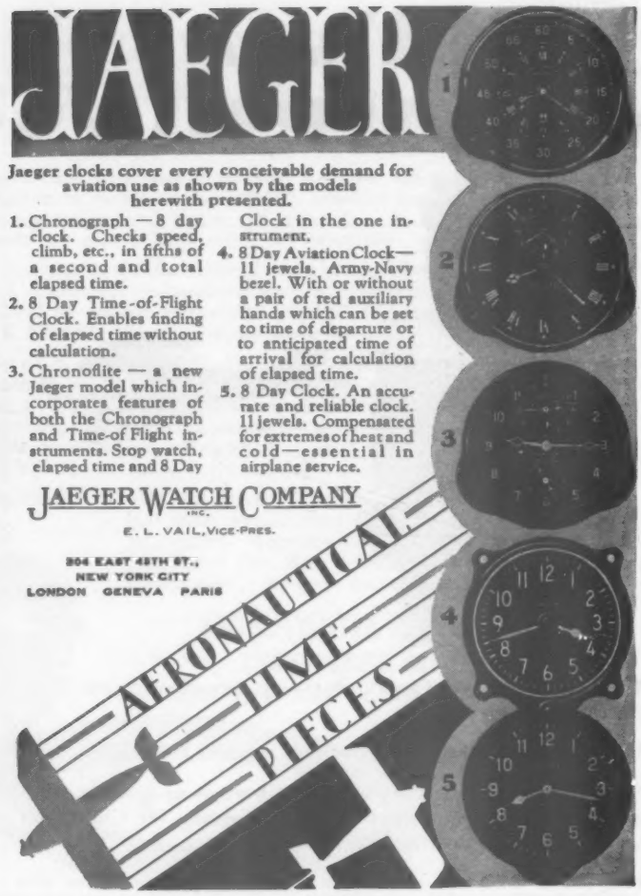
5. 8 Day Clock. An accurate and reliable clock. 11 jewels. Compensated for extremes of heat and cold — essential in airplane service.

JAEGER WATCH COMPANY INC.

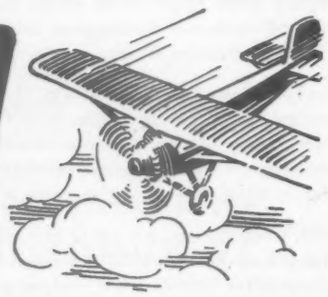
E. L. VAIL, VICE-PRES.

304 EAST 45TH ST.,
NEW YORK CITY
LONDON GENEVA PARIS

AERONAUTICAL TIME PIECES



Safe!



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For SPRINGS of any kind, of any material, for any purpose in motor, controls or landing gear, use

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Genuine ATECO Replacement Parts

J-6

J-6 Valve guides, intake R3807	$3.00
J-6 Valve guides, exhaust R3809	2.10
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Oil Ring	.35
New type Sectional Ring to replace Simplex	.60
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Valve guide exhaust	.85
Valve Intake	2.50
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Set Gaskets	5.00

J-5

40027 Complete set gasket	$2.00
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R-1724 Exhaust valve guide	3.95
R-1722 Intake valve guide	1.60
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R-1734 Intake pipe	2.00
R-1886 Valve springs, outer	.35
R-1888 Valve springs, intermediate	.30
R-1890 Valve springs, inner	.30
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(Continued from preceding page)

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Of Aviation, published monthly at New York, N. Y., for April 1, 1931.

State of New York } ss.
County of New York }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared C. H. Thompson, who, having been duly sworn according to law, deposes and says that he is the Secretary of the McGraw-Hill Publishing Company, Inc., publishers of Aviation, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to wit:

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Sworn to and subscribed before me this 31st day of March, 1931.
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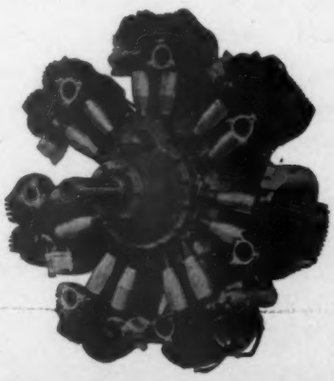

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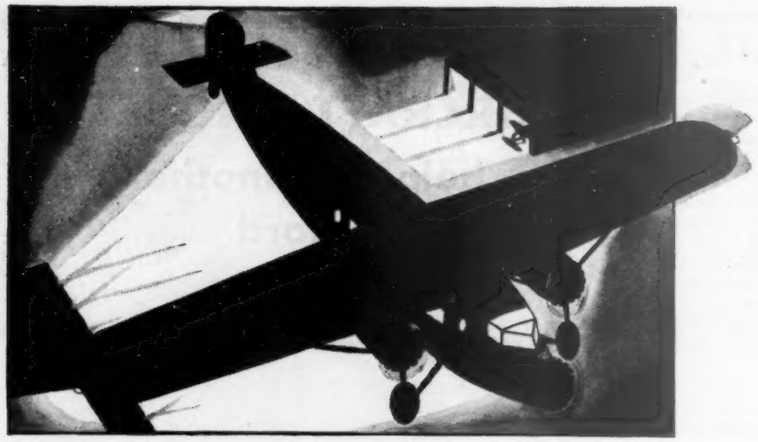

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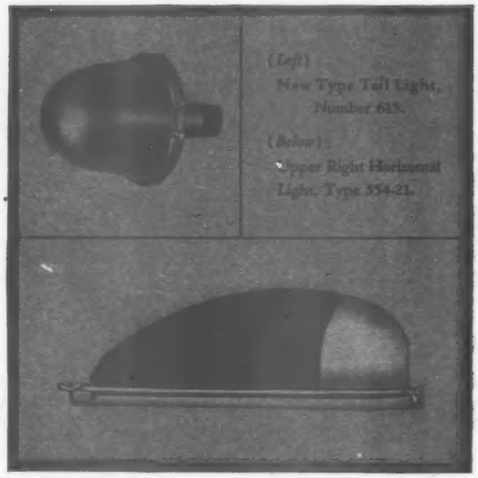

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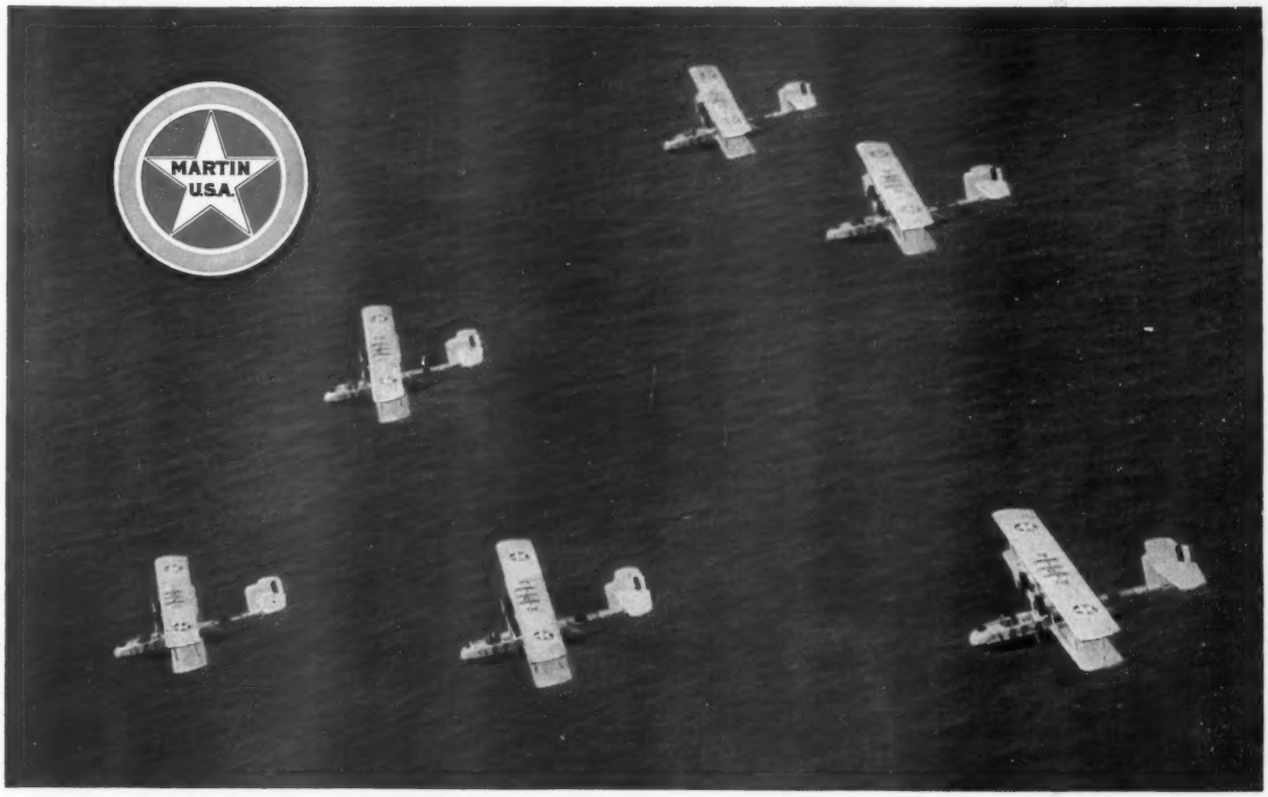

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from the New York Times of March 15, 1931

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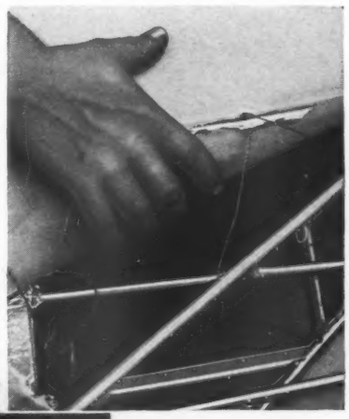

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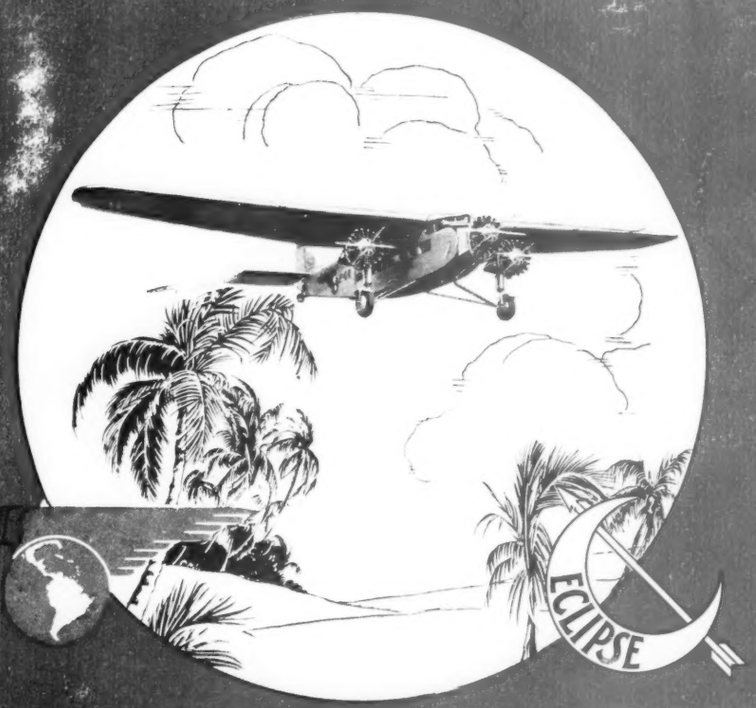

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